



# SHORE EROSION STUDY Technical Report

## Appendix 7

SHORELINE EROSION AND BLUFF STABILITY ALONG LAKE MICHIGAN  
AND LAKE SUPERIOR SHORELINES OF WISCONSIN

NORTHERN MANITOWOC, KEWAUNEE AND DOOR COUNTY  
SHORELINES OF LAKE MICHIGAN IN WISCONSIN

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COASTAL ZONE  
INFORMATION CENTER

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appendix 7

**WISCONSIN**  
COASTAL MANAGEMENT

This report has been prepared through the cooperative efforts of the Wisconsin Geological and Natural History Survey, the University of Wisconsin (Madison, Milwaukee, Parkside, and Extension), the Wisconsin Department of Natural Resources, and the Office of Coastal Management, Wisconsin Department of Administration. Assistance was further provided by Owen-Ayres and Associates.

This report is being reproduced quickly and in a limited quantity for dissemination to local governments and interested parties.

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## INTRODUCTION

This Appendix provides detailed information on shoreline conditions for the erodable Lake Michigan shoreline in northern Manitowoc, Kewaunee and Door Counties. The order of materials in the Appendix is from south to north. Parts of the shoreline are broken down by township and geographic section with each township. There is a text which describes the characteristics of shoreline conditions at the beginning of each section. For each township there is a map of the whole township which shows the sections, public perception of erosion hazards, shore damage in 1952, short- and long-term recession rates, bluff height, shore protection structure, houses per mile, and boat ramps.

For each geographic section (one mile long) a map shows locations of measured profiles along the shoreline. A running description of bluff characteristics, materials making up the toe of the slope, and beach characteristics is also given. Engineering data such as safety factor, the confidence level on this safety factor, and the distance the slope must retreat to attain a stable slope angle is also given. It should be noted that this distance assumes no wave cutting at the base of the bluff. This distance is referred to in the text as a stable slope distance. Also included with each section is a set of profiles from the water's edge to the bluff top. These profiles show stratigraphy, slope angles, circles of failure, and calculated safety factors along the shoreline. All profiles were measured during the summer of 1979. Remember that the bluff profile could have changed since the profiles were measured.

The meaning of abbreviations used in the Appendix is given on this page. For more detailed description of the methods used in compiling the data, regional interpretations, and conclusions about the engineering characteristics

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GB 459.5.M5 S5 Appendix 7

and types of slope failure taking place refer to the main report (Shoreline Erosion and Bluff Stability Along Lake Michigan and Lake Superior Shorelines of Wisconsin) available from the State Planning Office and the Wisconsin Geological Natural History Survey. A summary of the characteristics of the tills is given in Tables 1, 2, and 3.

#### Symbols Used

(used as nouns and adjectives)

|    |  |
|----|--|
| b  | boulders   |
| c  | clay or clayey   |
| co | cobbles  |
| f  | fine   |
| g  | gravel   |
| s  | sand   |
| sl | silt   |
| t  | till   |
| TR | Two Rivers till  |
| H  | Haven till   |
| O  | Ozaukee till   |
| FB | Forest bed   |
| SF | Factor of Safety   |
|    | A - unsatisfactory (1.00)  |
|    | B - questionable (1.00-1.25)   |
|    | C - satisfactory (1.25)  |
| CL | Confidence level   |
|    | A - high confidence - at borehole  |
|    | B - medium confidence - near borehole,<br>stratigraphy visible   |
|    | C - low confidence - away from borehole,<br>stratigraphy questionable  |
| SL | Stability line - the distance slope<br>must retreat to attain a stable<br>slope angle. This assumes no<br>erosion at toe and unchanged<br>conditions of nature of material<br>and water table. |

Table 1. Characteristics of Lake Michigan Lobe red tills. First parenthesis is standard deviation, second parenthesis in number of samples.

|            | 2 Sand      | 2 Silt      | 2 Clay      | 2 Illite    | 2 Expandable | 2 Chlorite  | 2 Calcite   | 2 Total       | 2 Magnetic  | 2 Predominant |
|------------|-------------|-------------|-------------|-------------|--------------|-------------|-------------|---------------|-------------|---------------|
|            | (%)         | (%)         | (%)         | (%)         | (%)          | (%)         | (%)         | (%)           | (%)         | Color         |
| Two Rivers | 13(3.9)(11) | 50(6.1)(11) | 19(5.3)(11) | 52(3.5)(42) | 35(4.0)(42)  | 13(2.5)(42) | .17(.2)(10) | 39.2(8.4)(10) | 437(2)(9)   | 5YR6/3        |
| Valders    | 30(9.6)(33) | 52(8.1)(33) | 18(7.9)(33) | 42(3.7)(53) | 46(5.0)(53)  | 12(2.7)(53) | .12(.1)(10) | 40.2(2.7)(10) | 547(4)(22)  | 5YR6/2        |
| Haven      | 16(7.1)(27) | 56(6.2)(27) | 28(6.6)(27) | 56(5.0)(58) | 25(4.5)(58)  | 19(3.2)(58) | .10(.1)(10) | 36.4(9.6)(10) | 526(11)(22) | 5YR6/4        |
| Ozaukee    | 13(3.9)(19) | 47(5.0)(19) | 40(6.5)(19) | 60(5.1)(20) | 20(5.8)(20)  | 20(2.3)(20) | .31(.2)(10) | 40.6(5.9)(10) | 411(8)(14)  | 5YR6/4        |

1. Percent of < 2 mm fraction. Boundaries used are 2mm, 0.6625 mm, and 0.002 mm.

2. Relative clay mineral percentages of < 2M fraction. Method modified from Glass (1977, personal communication). Method outlined in Acomb, 1978.

3. Based on Chittick analysis of < .0625 mm fraction, 30 gm sample.

4. Based on measurement of 15 gm. subsample of < 2 mm. fraction.

Table 3. Compressibility and preconsolidation of group 3 tills

| Unit    | C <sub>c</sub> | $\sigma'_c$ (ks/m <sup>2</sup> ) | $\bar{\sigma}'_o$ (ks/m <sup>2</sup> ) |
|---------|----------------|----------------------------------|--|
| Ozaukee | 0.19           | 440                              | 135                                    |
| Haven   | 0.14           | 700                              | 190                                    |
| Valders | 0.19           | 640                              | 160                                    |

Table 2. Average geotechnical properties of tills in eastern Wisconsin

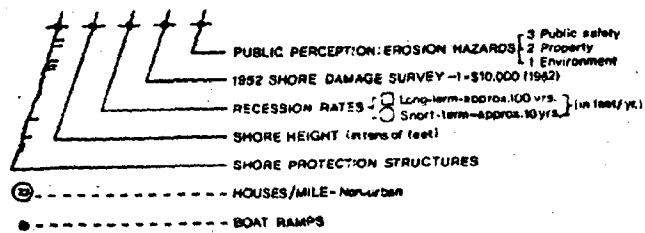
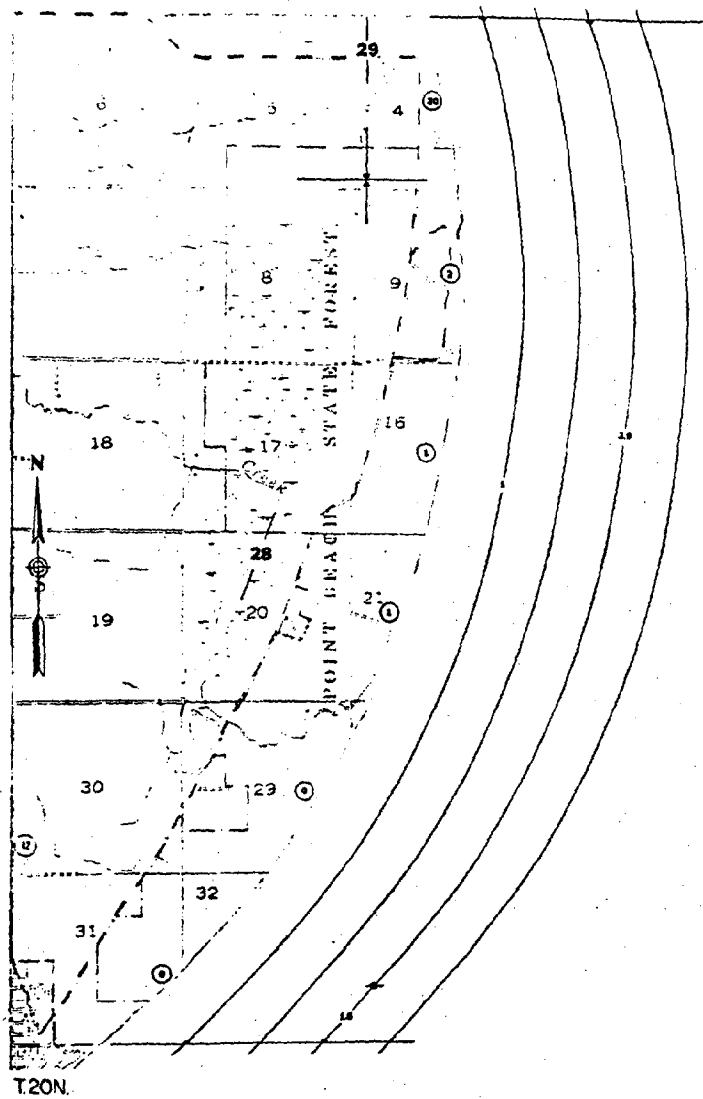
| Unit    | $\gamma_d$ (ks/m <sup>3</sup> ) | w (%)    | w <sub>L</sub> (%) | f <sub>p</sub> (%) | $\phi$ (degrees) | c' (ks/m <sup>2</sup> ) |
|---------|---------------------------------|----------|--------------------|--------------------|------------------|-------------------------|
| 1A      | 19.6                            | 4.8      | Non-plastic        |                    | 34.6             | 0                       |
| 2A      | 18.6±0.6                        | 15.8±3.1 | 24.5±2.9           | 9.9±1.9            | 31.1±0.1         | 0                       |
| 2B      | 18.5±0.6                        | 15.2±1.4 | 25.1±2.8           | 10.0±2.3           | 31.4±            | 0                       |
| 2C      | 18.7±                           | 15.7±    | 23.4±2.1           | 10.2±2.0           | 30.5±            | 0                       |
| Ozaukee | 17.9±0.4                        | 17.6±1.2 | 30.6±2.6           | 14.0±2.5           | 31.4±0.8         | 0                       |
| Haven   | 18.6±0.9                        | 16.5±2.5 | 30.3±6.0           | 14.4±4.7           | 31.2±0.5         | 23.8±5.6                |
| Valders | 17.7±1.2                        | 17.4±4.1 | 28.4±5.0           | 13.1±3.4           | 29.3±0.6         | 28.1±6.9                |

\* Unit dry weight

Note: standard deviation not calculated when less than 4 samples.

T. 20 N., R. 25 E.

No bluff shoreline exists in this township. Most of the area is contained in Point Beach State Park. The beach varies in width from 20-100 feet. Because of the low slope beach width changes considerably with changes in water level. In much of the Park dunes are present above the beach. These dunes are subject to erosion by wind when vegetation is disturbed but no evidence of wave erosion on the dunes was noted. Some rip-rap has been placed in front of houses at the north end of the section.



T. 21 N., R. 24 E.

## T. 21 N., Sec. 31

This section is similar to the shoreline of Point Beach State Park, as well as the mile of shoreline immediately to the north of the park. This area contains no bluffs except for occasional wave cut sand banks which do not exceed 10 feet in height. The foreshore is 10 to 50 feet wide and made of sand with occasional pebbles. Behind the beach is a zone of dunes 200 to 500 feet wide. This zone is 10 to 60 percent vegetated with herbs and shrubs and has a hummocky topography with up to 15 feet of relief. Several of the larger closed depressions contain ephemeral ponds. The landward edge of the dune zone borders on a mixed deciduous forest.

## T. 21 N., Sec. 30/25

Section 30/25 contains areas with and without bluffs. The extreme south end of the section (a) consists of a sand beach 50 to 70 feet wide. The bluff rises toward the north (b) to a height of 20 to 30 feet. The bluff is unvegetated except for a few large trees that have slid down from above near 30/25.2 and consists of 10 to 15 feet of sand over 15 feet of clayey till (Haven) which is covered by slump material. The beach is approximately 40 feet wide. From 30/25.2 to 30/25.6 the bluff consists of discontinuous clay till (Two Rivers) to 10 feet thick over discontinuous medium to fine sand 0 to 6 feet thick over 4 to 10 feet of clay till (Haven) covered with debris. Seeps are present along the lower sand/till interval, and failures are primarily shallow slides. The beach is generally 20 to 50 feet wide along this subsection, but narrows near profile 1 to less than 10 feet.

From 30.25.6 north to the end of the section (c), the bluff steadily decreases in height, disappearing at 30/25.8. The beach is 20 to 50 feet wide



and consists mostly of small dunes except near the mouth of the stream where it is made up of alluvium.

T. 21 N, Sec. 24

Section 24 can be divided into three subsections. The area (a) from the southern edge of the section to 24.3 consists of a 50 to 100 foot wide sand beach developed on a low, flat terrace less than 10 feet above lake level.

The shore from 24.3 to 24.9 is protected by rip-rap (b). A small boat launching ramp is at mile 24.4, and from 24.6 to the north end of the section a 10 to 20 foot high bluff is developed. At 24.7 two steel piers extend approximately 150 feet into the lake as part of the cooling system of the Point Beach Nuclear Power plant.

From 24.9 to the north end of the section (c) the bluff is unprotected. The beach is 25 to 40 feet wide and consists of sand with occasional pebbles and cobbles.

T. 21 N., Sec. 13

Section 13 (a) contains 30 to 50 foot high bluffs consisting of 10 to 20 feet of red clay till (Two Rivers) over a discontinuous sand layer which overlies 2 feet in thickness, over a discontinuous, 0 to 5 foot layer of till (Haven), over about 20 feet of gray, lacustrine silt and clay. Seeps are present at the tops of the middle till unit and the lacustrine sediments. The location of the base of the lacustrine sediment is unknown as the toe is covered by debris from shallow failures.

Vegetation is limited to blocks of sod and a few trees which have slid down from above.

The beach is 5 to 20 feet wide and consists of sand with scattered pebbles.

## T. 21 N., Sec. 11

The bluff (a) in sec. 11 rises from 20' high at the south end to 40 feet high at the north end of the section. The bluffs are sparsely vegetated and consist of a discontinuous sand layer up to seven feet thick in places, overlying 8 to 15 feet of red clay till (Two Rivers). This till overlies one or two other till units at the north end of the section and lacustrine silts and clays at the south end. Between the tills and the lacustrine sediments is a discontinuous horizon of sand and logs from the Two Creeks Forest Bed. Numerous seeps are observed at stratigraphic breaks, especially at the top of the upper clay till unit.

The toe is uneven and largely covered by debris from shallow slides and small slumps.

The beach is 18 to 20 feet wide and consists of sand with pebbles except at the mouths of the two streams where the bluff is cut down and the beach doubles in width.

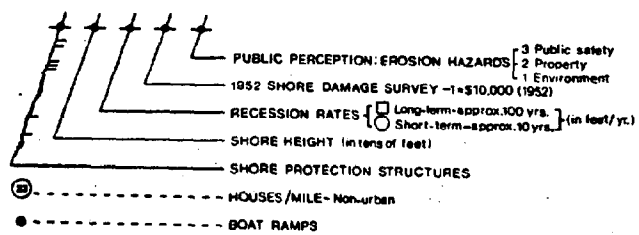
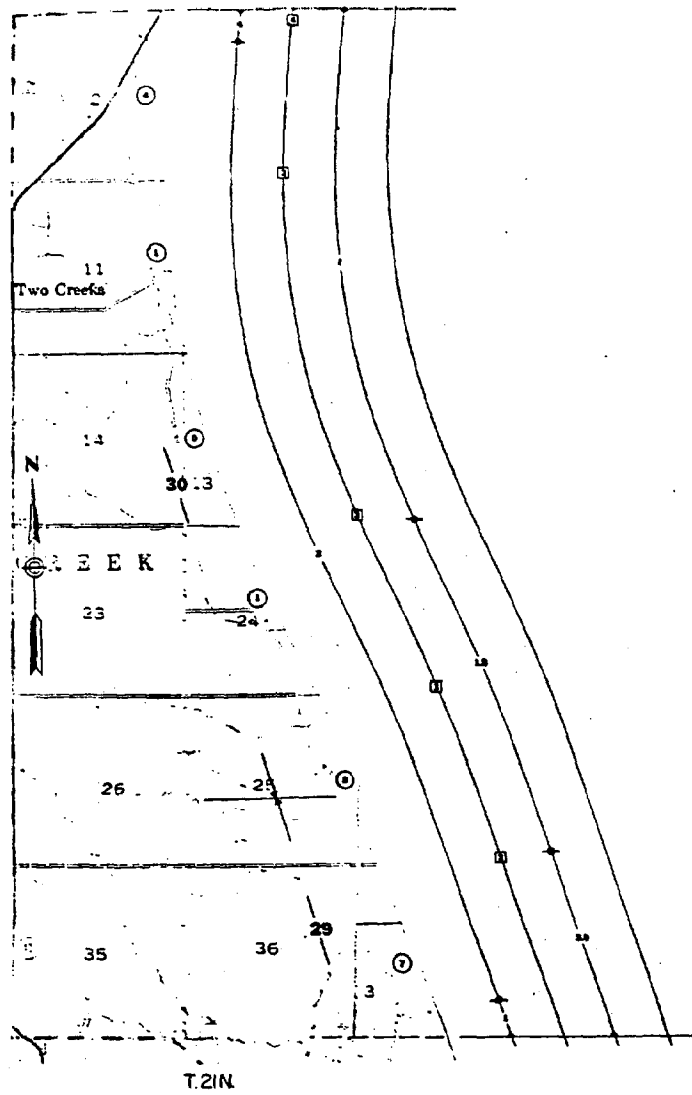
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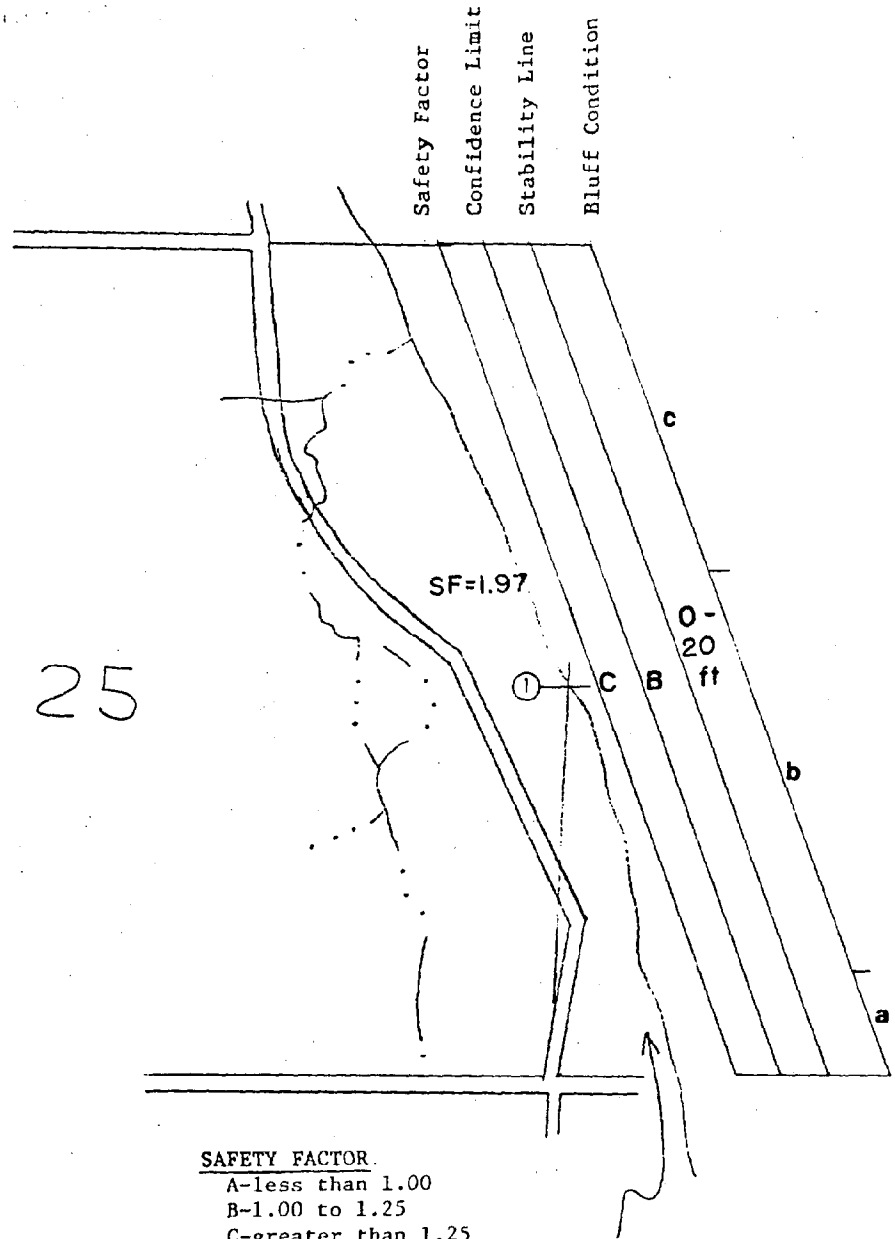
The bluff and beach of section 2 may be divided into three segments. The southern one-half of the section (a) consists of bluffs 25 feet high. The bluff is 20 percent vegetated and consists of 2 to 5 feet of sand overlying 10 feet of the clayey Two Rivers Till which overlies 10 to 12 feet of another clay till unit (Haven). A few small slump blocks were observed. The beach in this subsection is 10 to 20 feet wide and consists of sand with scattered pebbles.

From 2.5 to 2.7 (b) the bluff is 25 feet high and nearly vertical. The steep face is caused by a small stream flowing parallel to, and behind the bluff, thus draining the bluff and increasing the soil's shear strength. The

bluff in this subsection consists of 18 feet of folded mixture of sand and clay till overlying the Two Creeks Forest Bed, which overlies another red clay till unit, the base of which is not visible. The sand beach in this subsection is about 35 feet wide.

The final subsection (c) runs from 2.7 to the end of the section. The bluff is 25 to 30 feet high and is made up of 6 feet of Two Rivers till over sand, silt and clay layers. The lower half of the bluff is covered by numerous slump blocks. Water flows from numerous seeps and collects in pools behind the slump blocks. Horsetails are the dominant vegetation. The beach ranges from 5 feet wide beneath large bluff failures to 40 feet wide and is made of sand.



SAFETY FACTOR

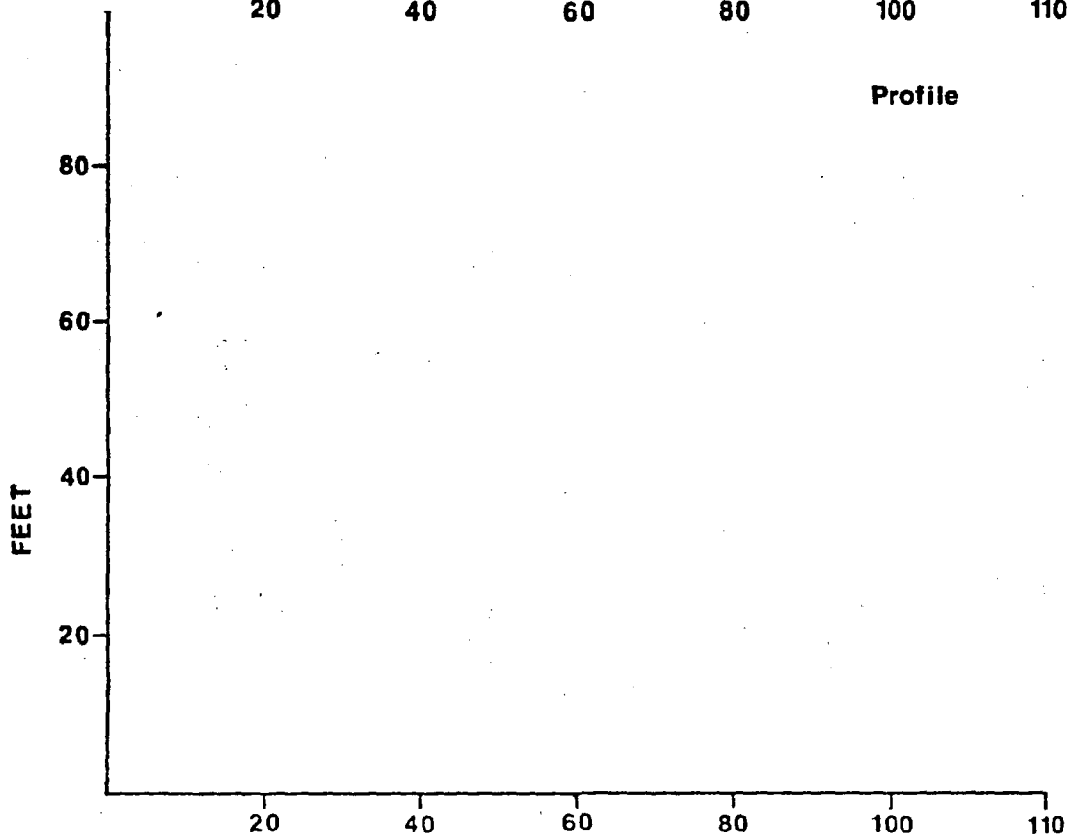
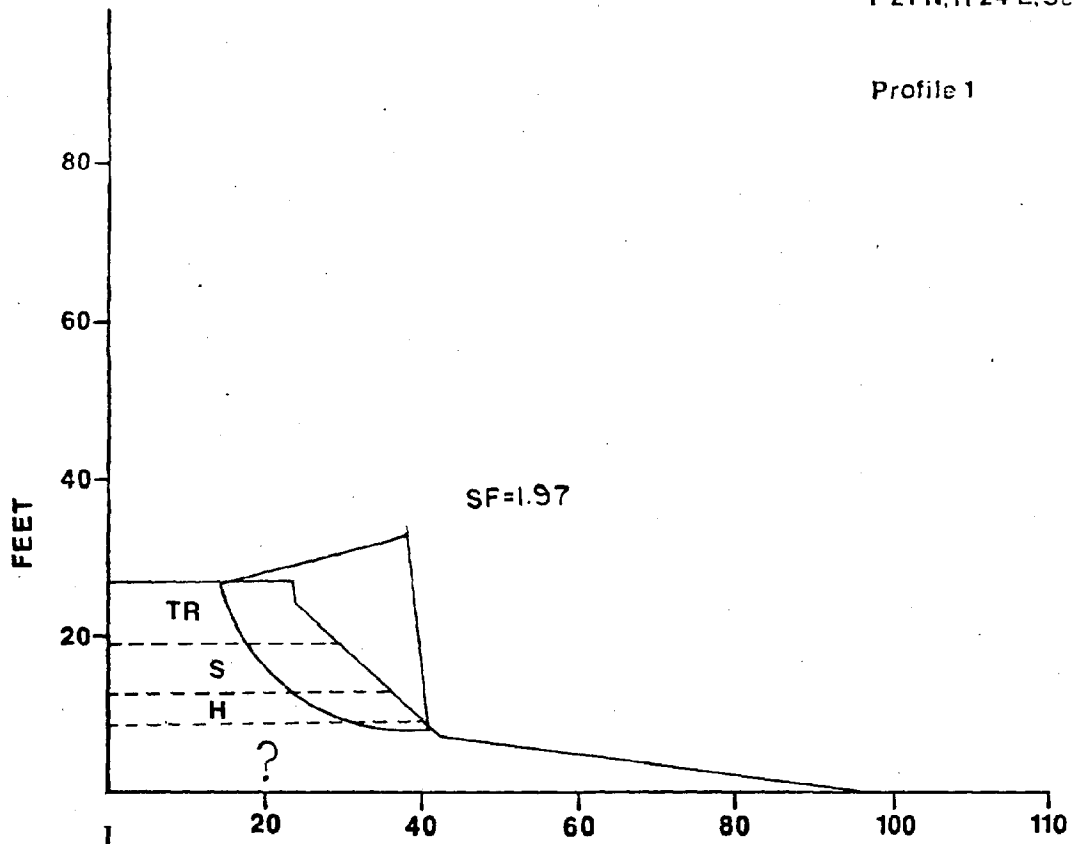
- A-less than 1.00
- B-1.00 to 1.25
- C-greater than 1.25

CONFIDENCE LEVEL

- A-boreholes  
(high confidence)
- B-near boreholes  
stratigraphy visible
- C-no stratigraphy  
visible (low  
confidence)

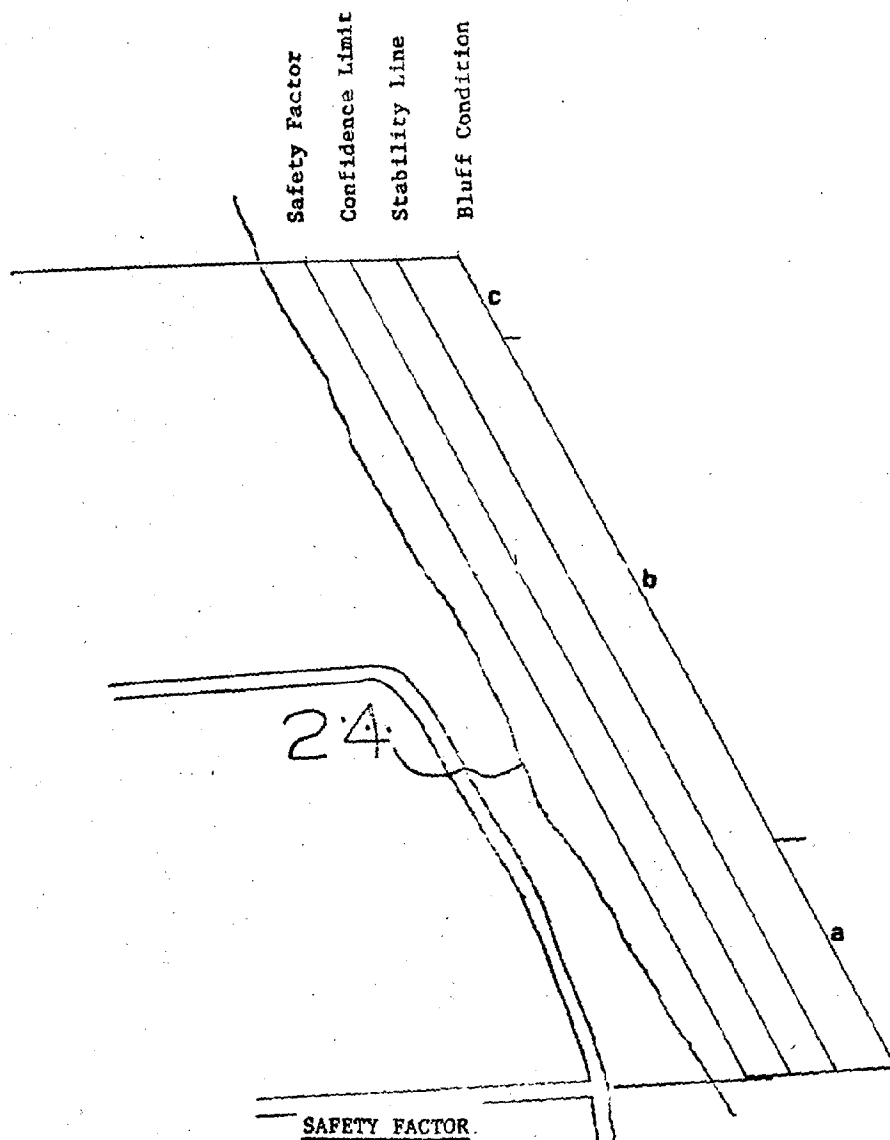
T 21 N, R 24 E, Sec. 25

Profile 1



T. 21N., R. 24E.

(Keweenaw)



Safety Factor  
 Confidence Limit  
 Stability Line  
 Bluff Condition

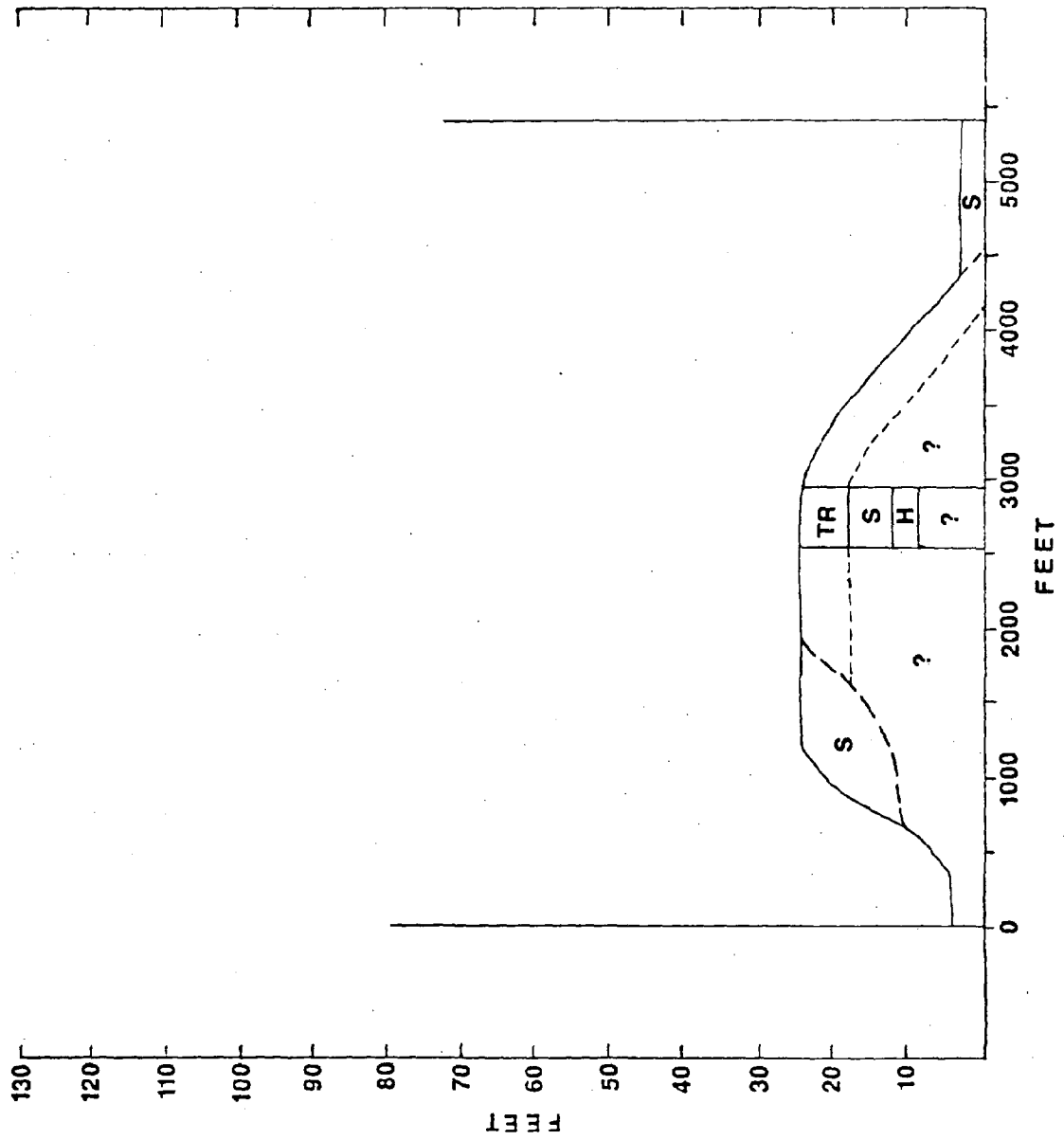
SAFETY FACTOR.

- A-less than 1.00
- B-1.00 to 1.25
- C-greater than 1.25

CONFIDENCE LEVEL

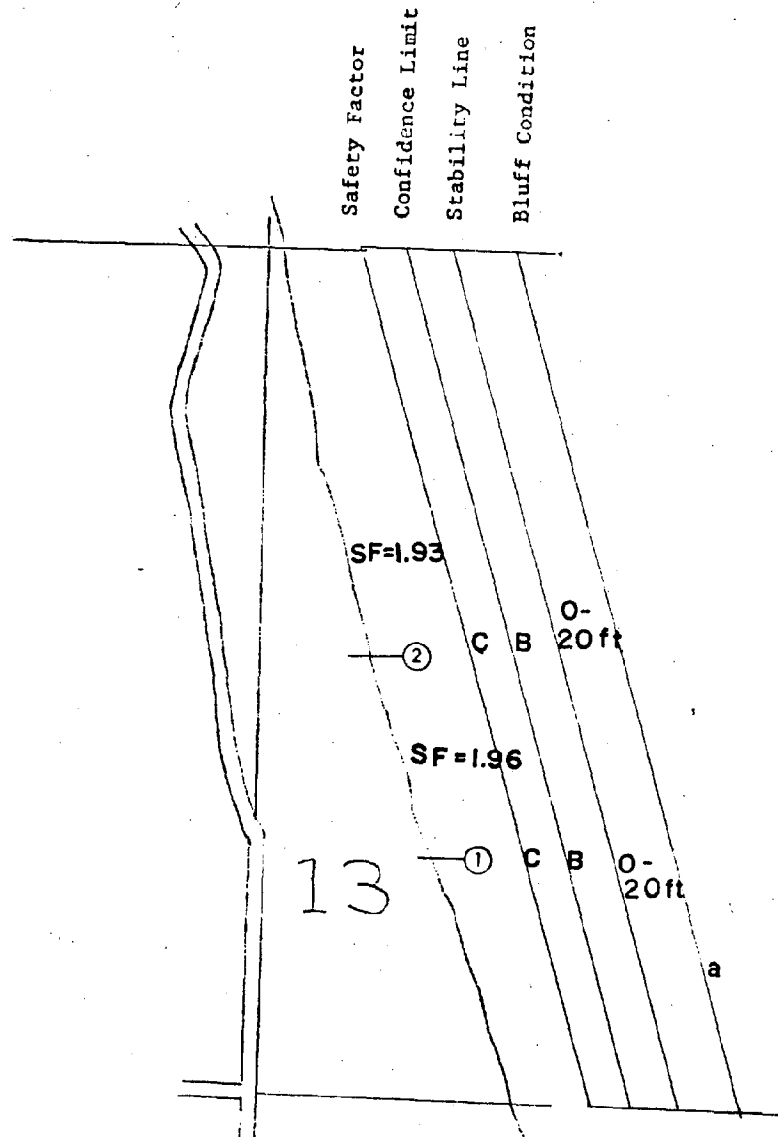
- A-boreholes  
 (high confidence)
- B-near boreholes  
 stratigraphy visible
- C-no stratigraphy  
 visible (low  
 confidence)

T21N, R24E, SEC. 25





UT 31N, T34E  
(Bureau of Land Management)



SAFETY FACTOR

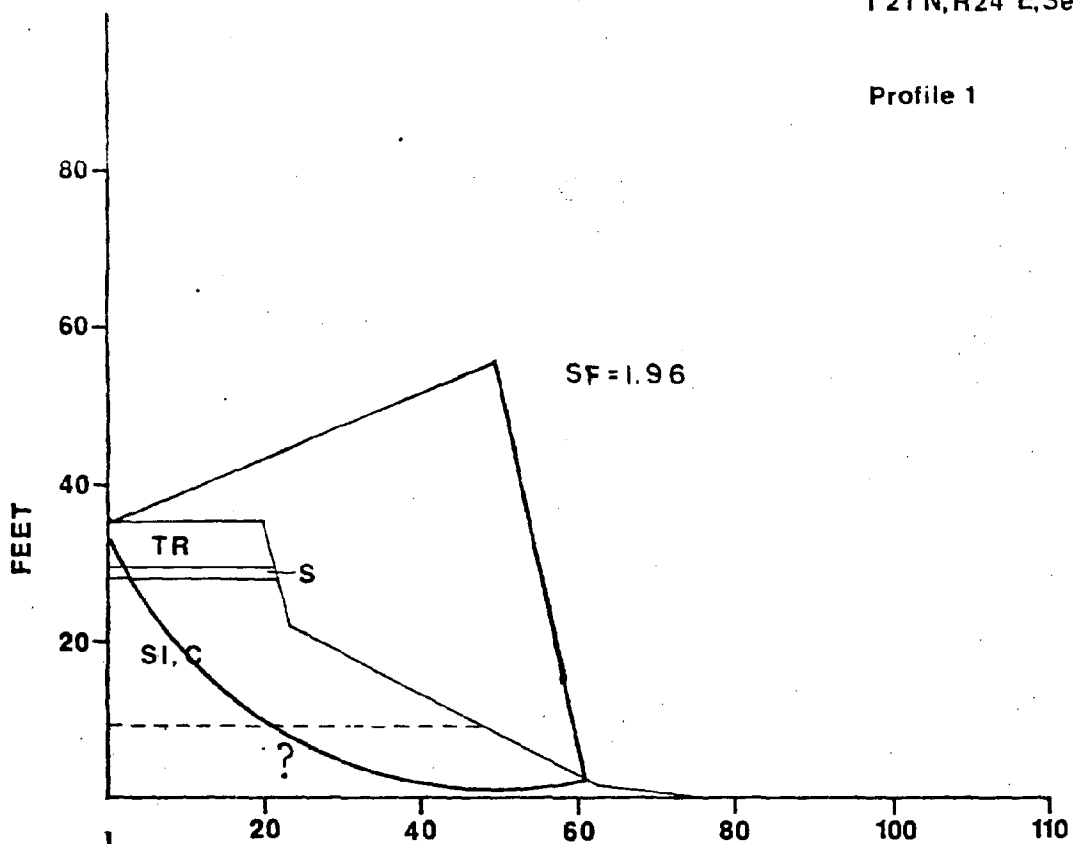
- A-less than 1.00
- B-1.00 to 1.25
- C-greater than 1.25

CONFIDENCE LEVEL

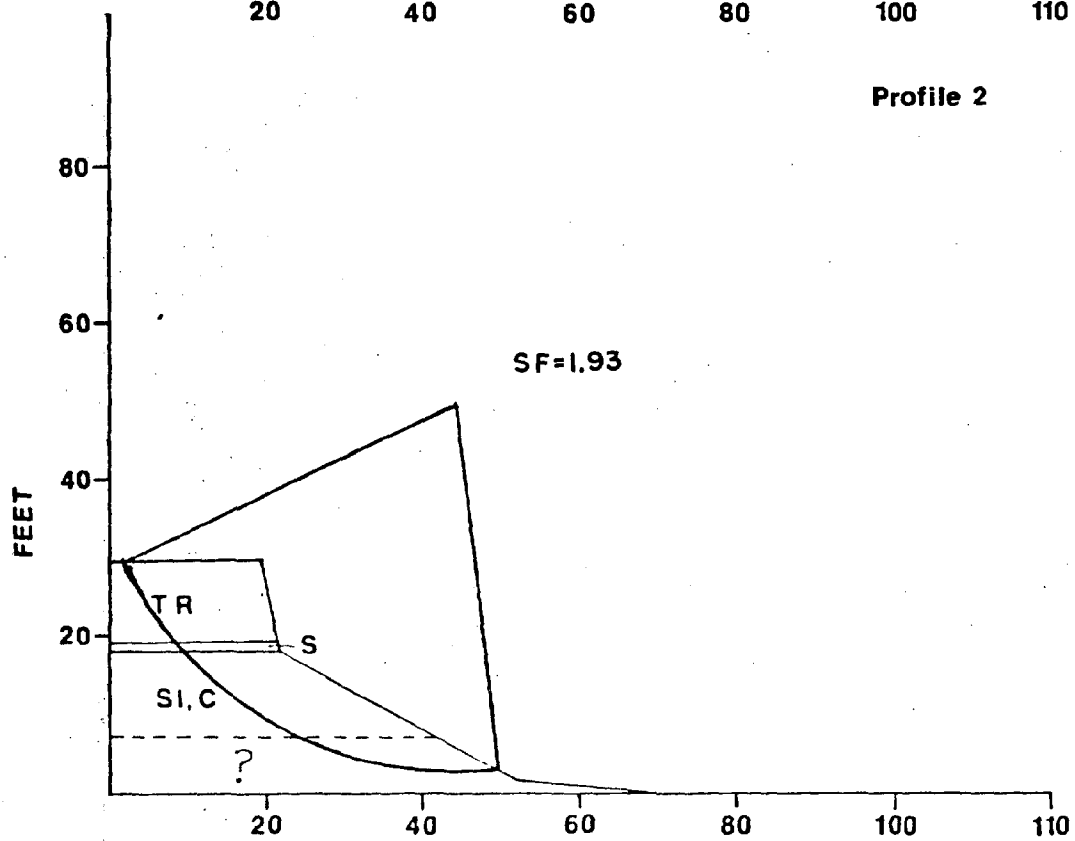
- A-boreholes  
(high confidence)
- B-near boreholes  
stratigraphy visible
- C-no stratigraphy  
visible (low  
confidence)

T 21 N, R 24 E, Sec. 13

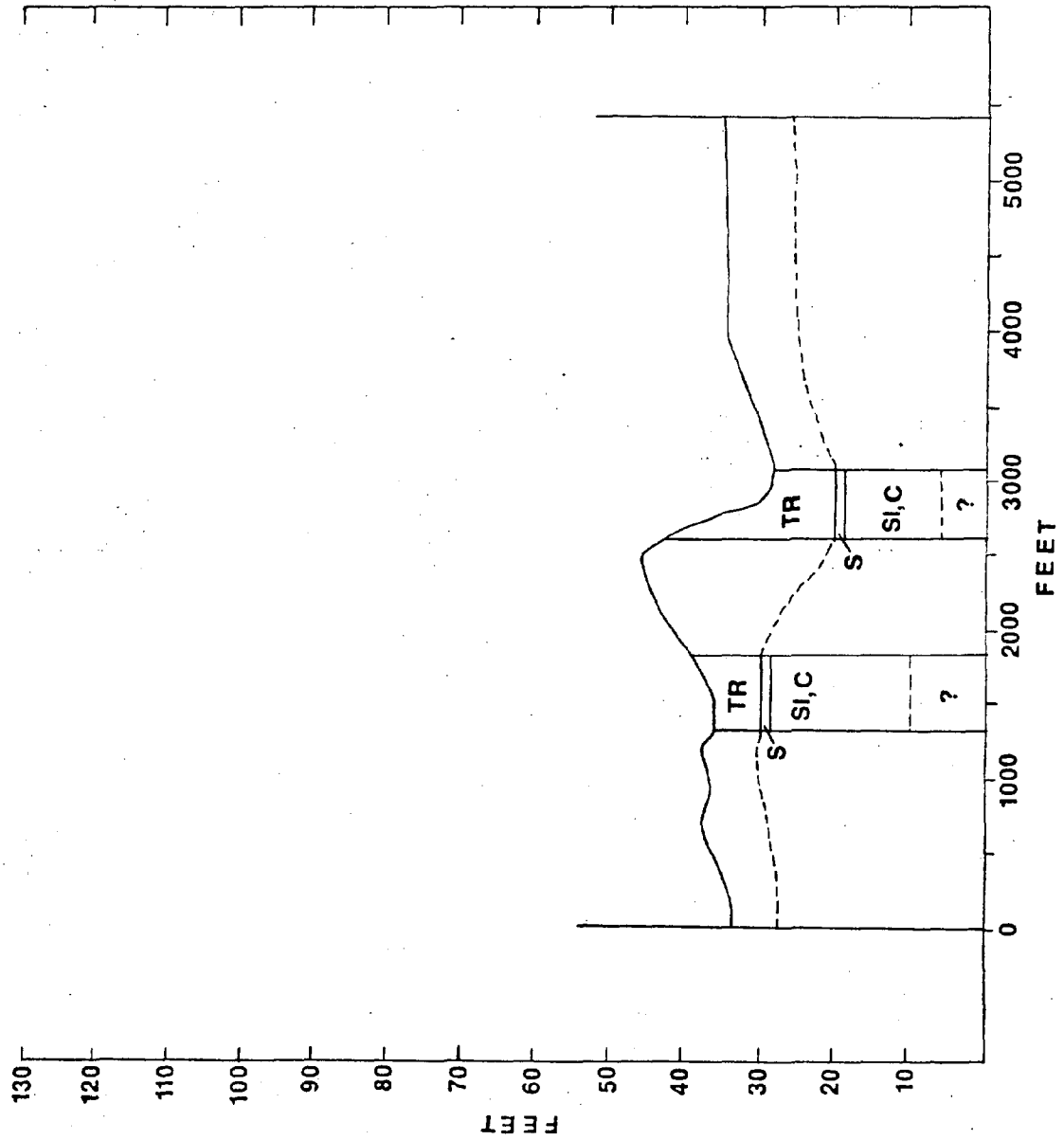
Profile 1



Profile 2



## T21N.R24E SEC.13



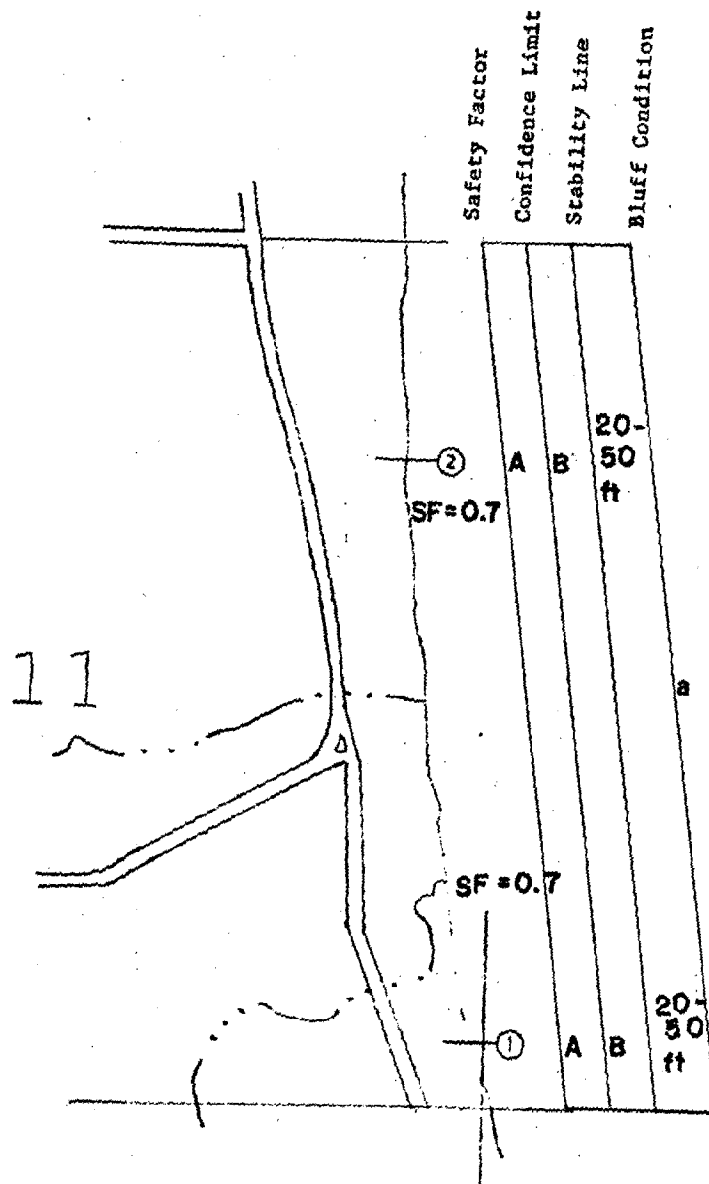
T.21N, R.24E  
 (KLE) (S) (S)

SAFETY FACTOR

- A-less than 1.00
- B-1.00 to 1.25
- C-greater than 1.25

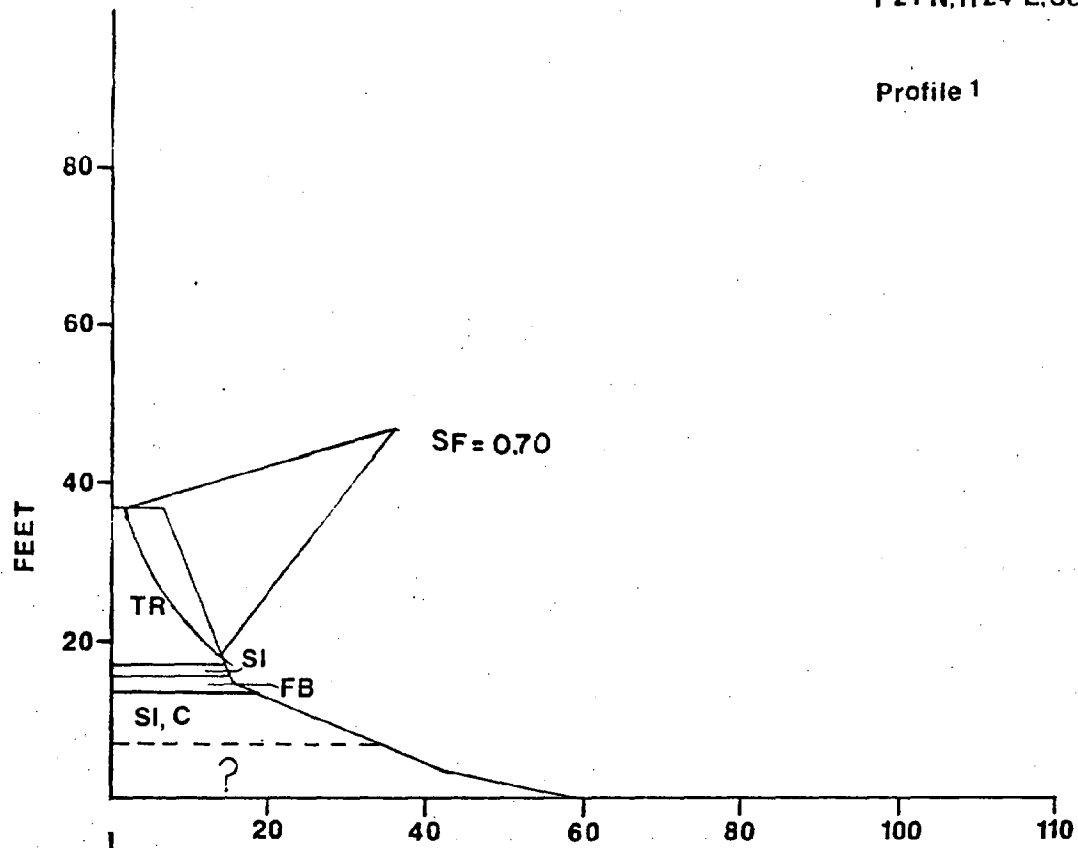
CONFIDENCE LEVEL

- A-boreholes  
 (high confidence)
- B-near boreholes  
 stratigraphy visible
- C-no stratigraphy  
 visible (low  
 confidence)

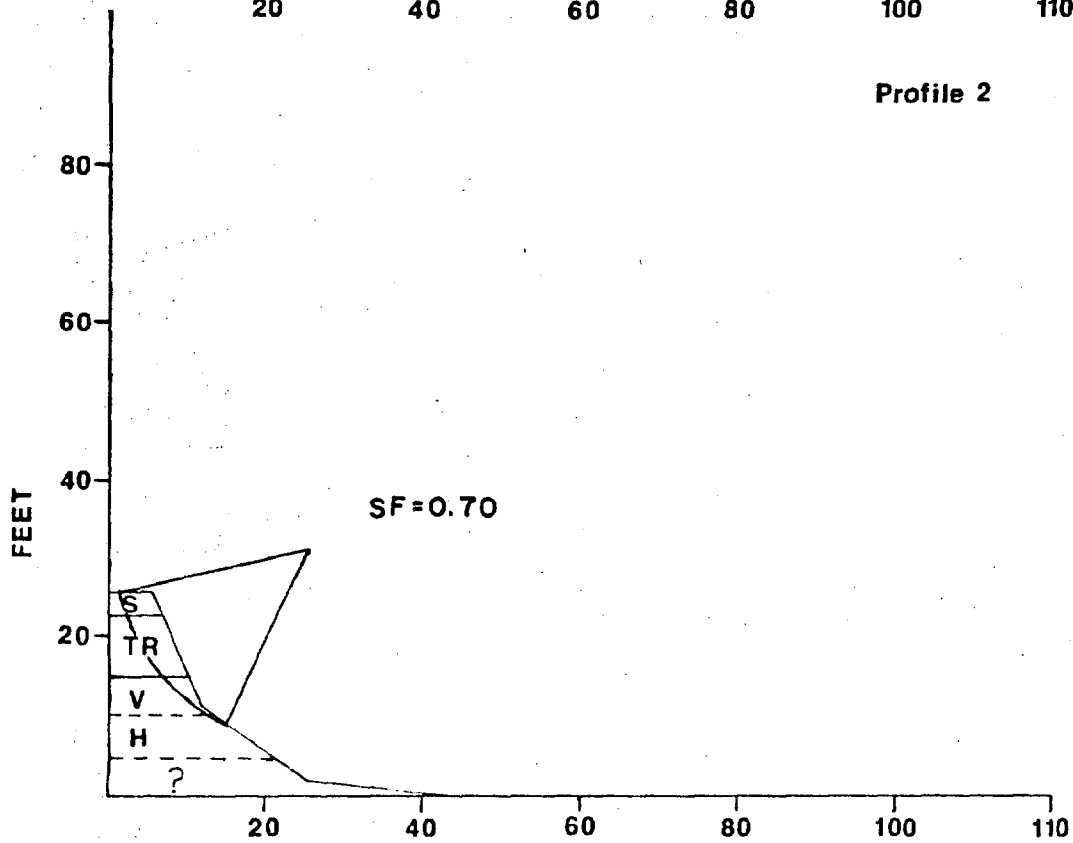


T 21 N, R 24 E, Sec. 11

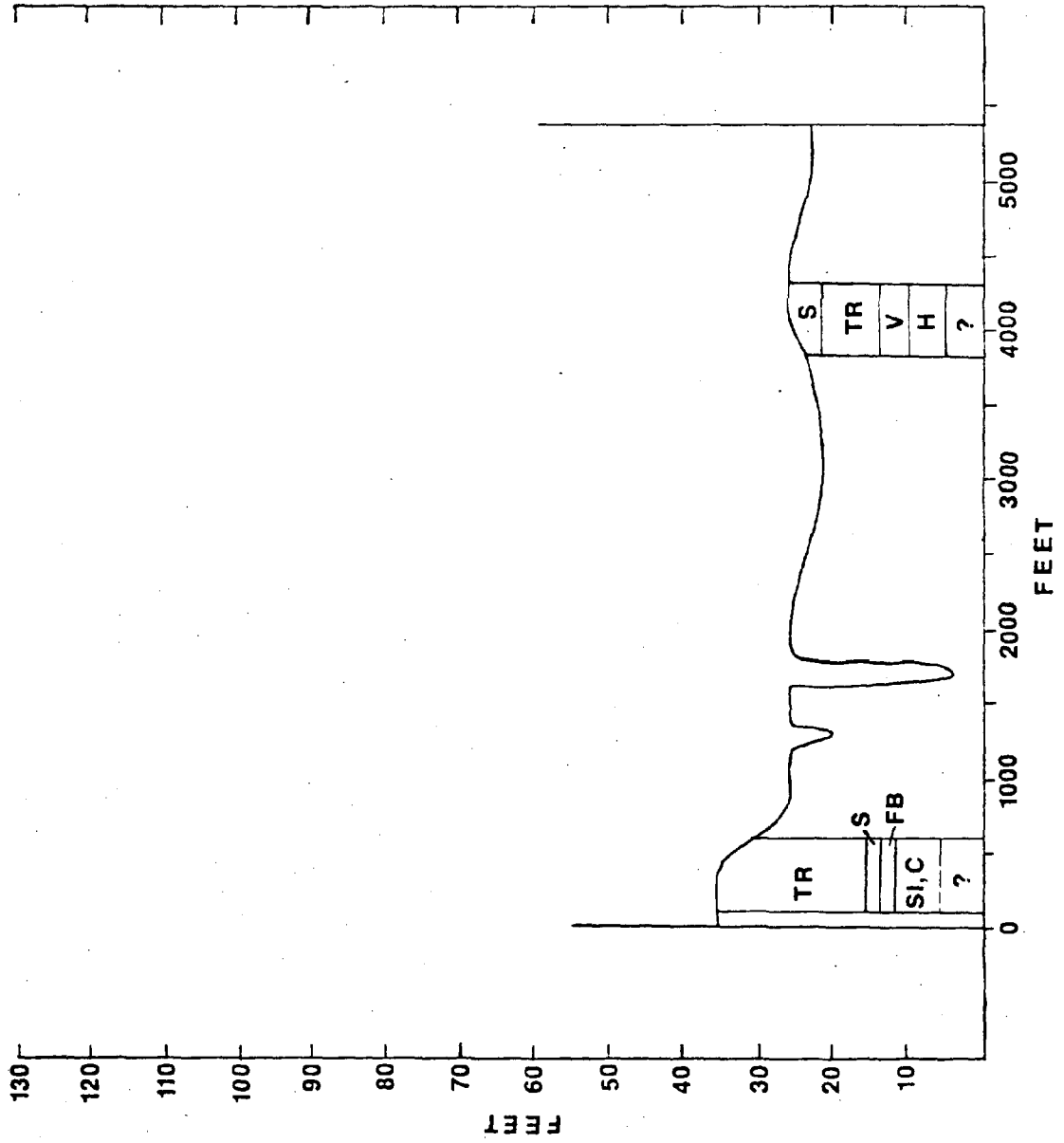
Profile 1



Profile 2

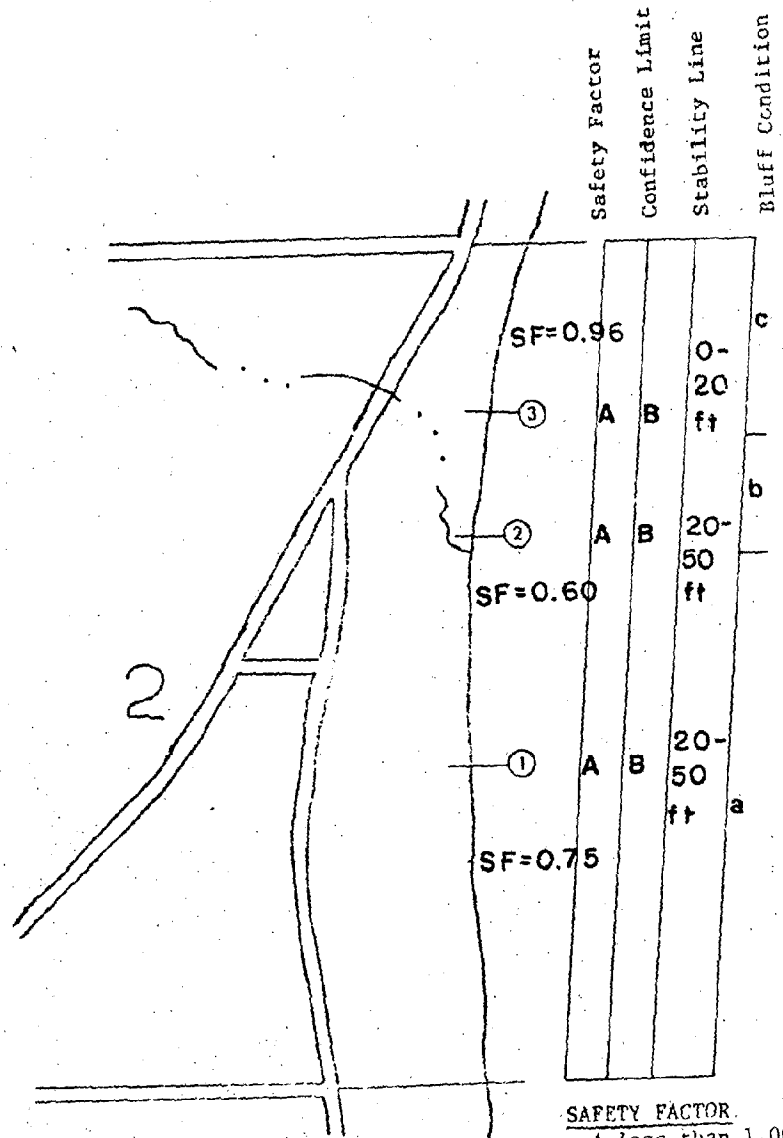


T21N, R24E, SEC. 11



11.21.1. R.24E

(KAWAUNELI)



SAFETY FACTOR.

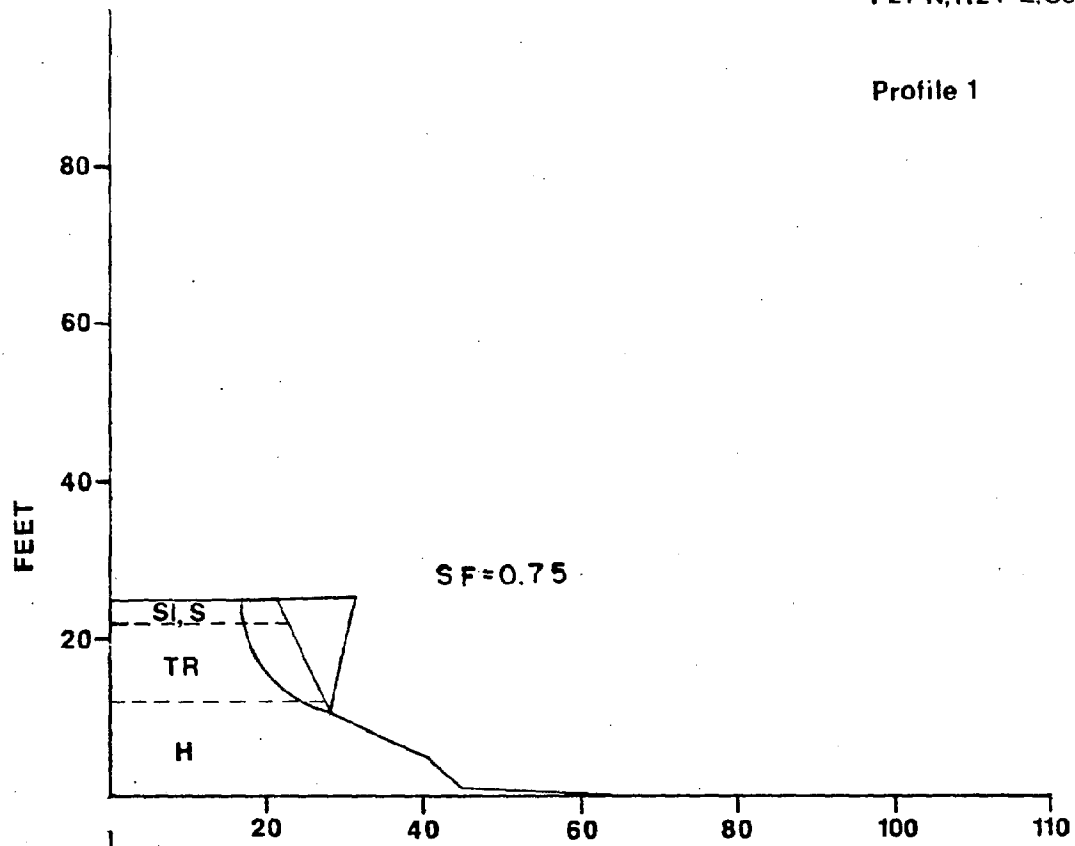
- A-less than 1.00
- B-1.00 to 1.25
- C-greater than 1.25

CONFIDENCE LEVEL

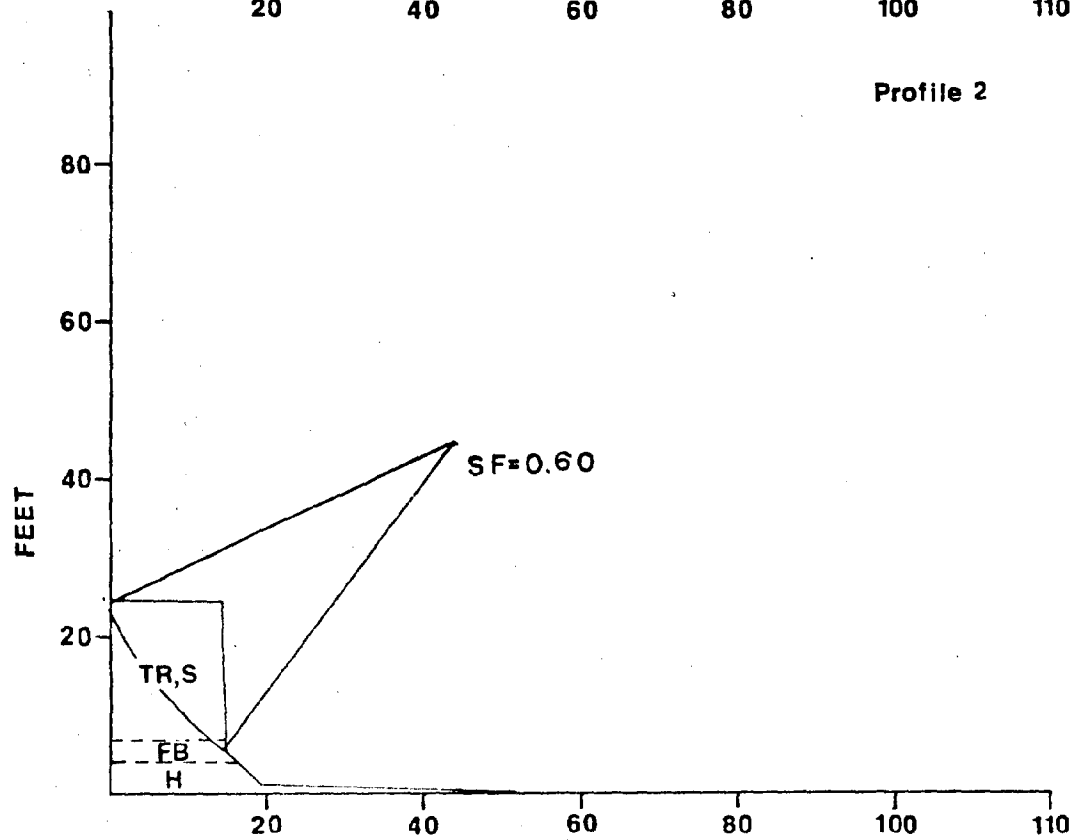
- A-boreholes (high confidence)
- B-near boreholes stratigraphy visible
- C-no stratigraphy visible (low confidence)

T 21 N, R 24 E, Sec. 2

Profile 1



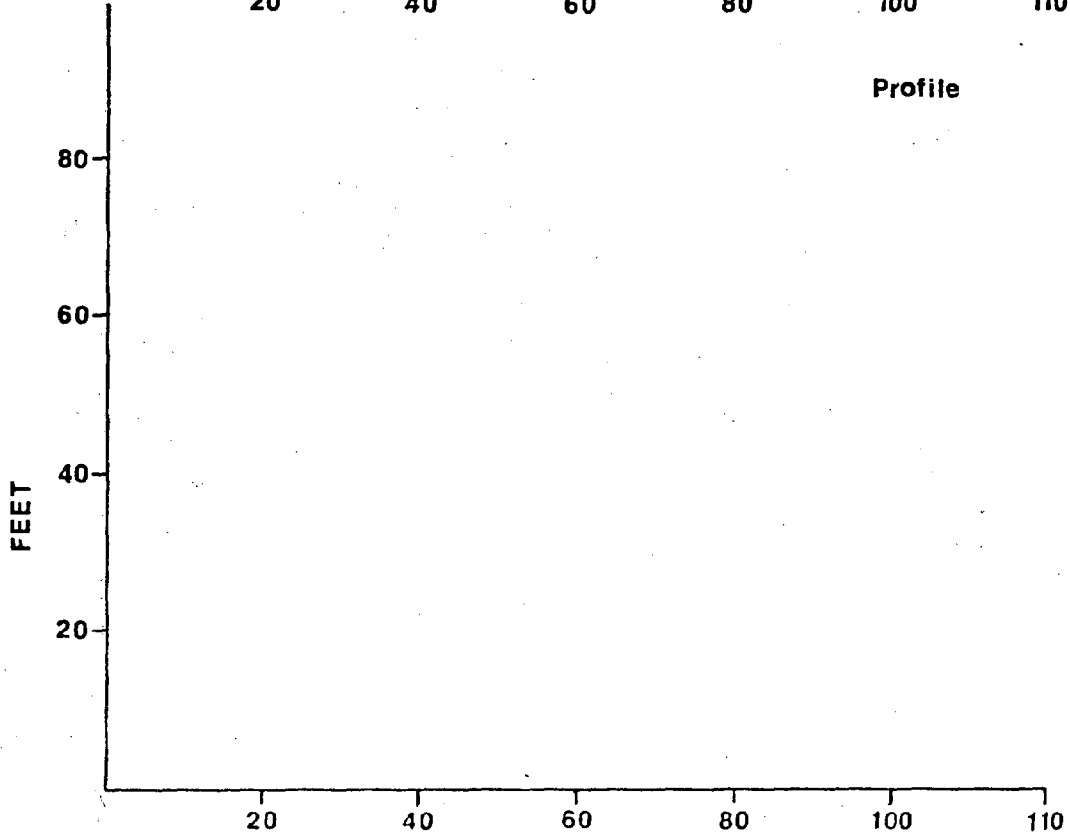
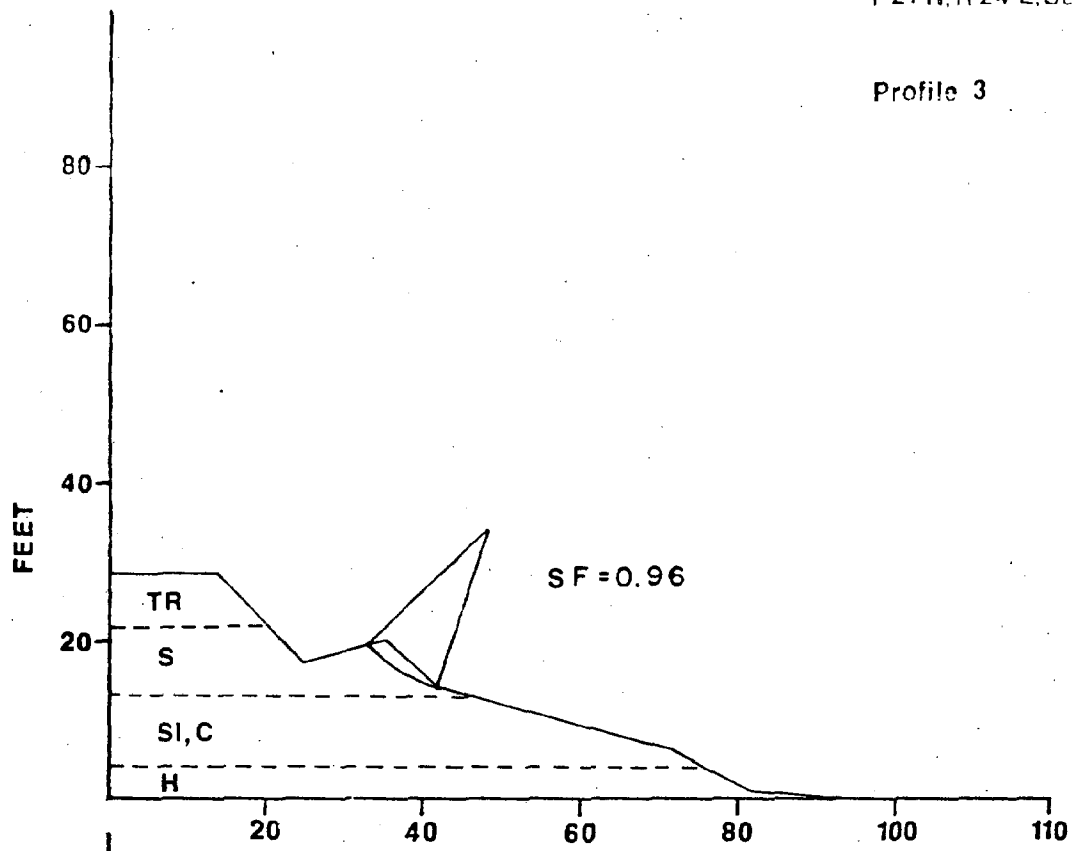
Profile 2



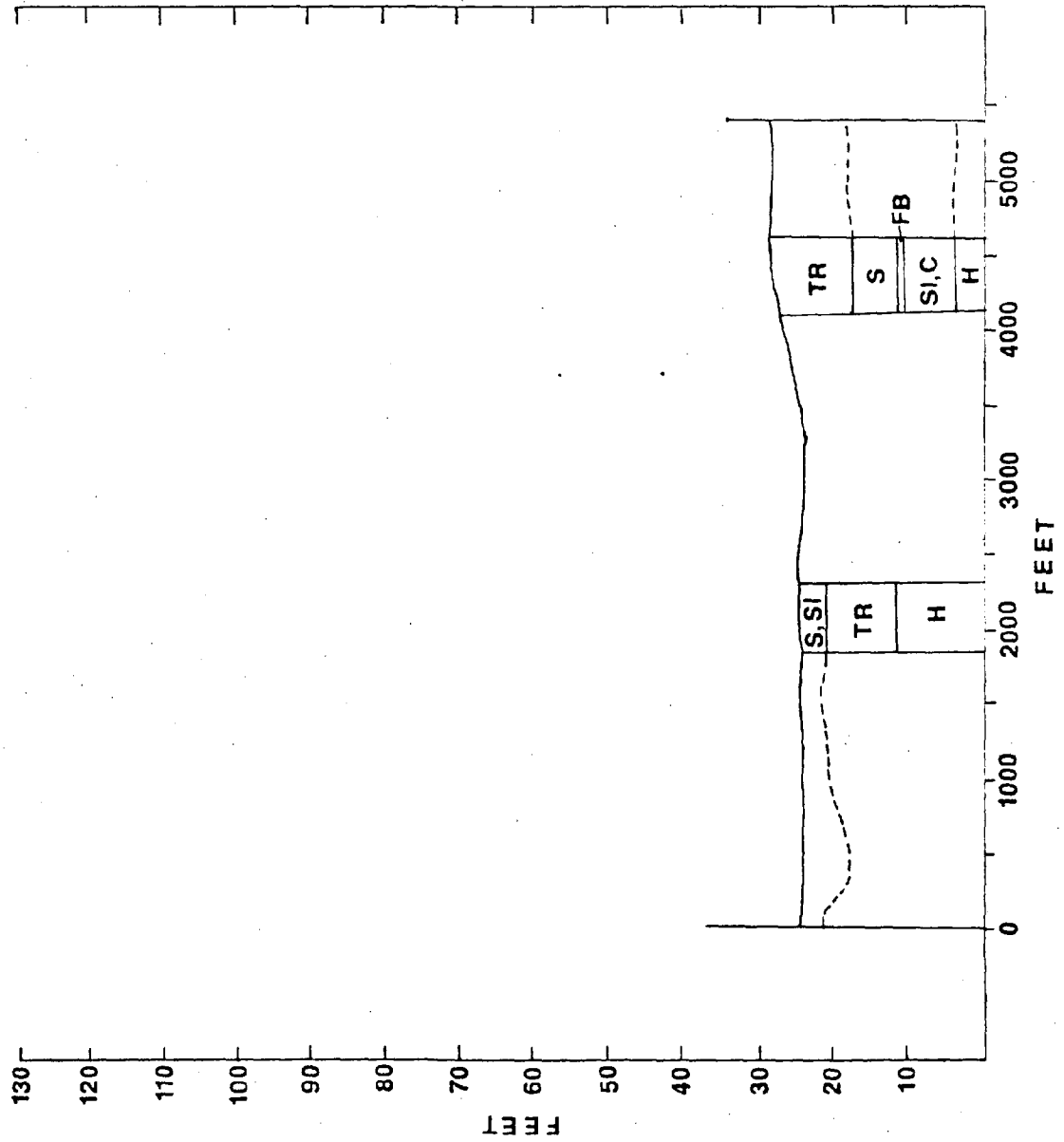


T 21 N, R 24 E, Sec. 2

Profile 3



## T21N, R24E, SEC. 2



T. 22 N., R. 24 E.

## T. 22 N., Sec. 36

The bluff and beach of section 36 can be divided into two subsections. The southern three-fourths of the section (a) contains 20-to-40 foot high bluffs. The bluffs are sparsely vegetated except for a small area at 36.1 which is 50 percent vegetated. The stratigraphy consists of approximately 8 feet of clayey Two Rivers till overlying a sand layer which varies in thickness from 2 to 10 feet. At the south end of the section the sand overlies logs of the Two Creeks Forest Bed which overlie 20 to 25 feet of lacustrine silts and clays. In the north three-fourths of the section the forest bed is absent and the sand lies directly upon the lacustrine sediments. The lower half of the bluffs in this subsection are covered by debris from shallow slides and small slumps. The beach width ranges from zero below recent failures to 25 feet and consists of sand and sand with pebbles and cobbles.

The northern one-quarter of the section (b) contains gently sloping, vegetated bluffs 20 to 30 feet high. At the extreme north end of the section, at the Keweenaw Nuclear Power Plant, the beach and bluff are protected with rip-rap.

## T. 22 N., Sec. 25

Section 25 lies immediately north of the Keweenaw Nuclear Power Plant. The southern end of the section contains only a low sand terrace, the southern extremity of which is protected by rip-rap. On the non-protected end of the terrace is developed a sand beach 20 to 50 feet wide.

The bluff begins to rise at 25.1 to a height of 20 to 40 feet.

In the northern section (b), the top half of the bluff is unvegetated while the lower half is 80 percent vegetated and covered with debris. The

dominant mode of bluff failure in this section is by sliding, although a few small slump blocks are present. Bluff stratigraphy consists of 0 to 10 feet of sand and discontinuous pods and layers of red clay till (Two Rivers) overlying 20 to 30 feet of gray silt and clay. The beach is generally 20 to 45 feet wide and is made up of sand and pebbles.

T. 22 N., Sec. 24

Section 24 contains high bluffs which can be divided into two subsections based primarily upon amount of vegetation and slope failure type. In the southern third of the section (a) the bluffs range in height from 50 to 80 feet. The upper portion of the slopes are practically unvegetated while the lower one-third supports some grass and horsetails. Some small slumps are present, however the dominant mode of bluff failure in this subsection is shallow slides. The bluff materials consist of 20 to 40 feet of fine to medium sand over 25 to 30 feet of gray silt and clay. The sand unit thickens toward the north. The beach in this subsection is 5 to 20 feet wide and is made up of sand with pebbles.

In the northern two-thirds of the section (b) the bluffs are 60 to 70 feet high and 70 to 90 percent vegetated. While shallow slides are still the dominant mode of bluff failure, small slumps assume greater importance in this subsection, especially in the northern part. Stratigraphy is the same as in the southern subsection except that 4 to 6 feet of clayey Two River till caps the bluff, and up to 10 feet of gray, clay till containing cobbles and boulders is exposed at the toe. The beach in this subsection is less than 20 feet throughout and consists of sand with cobbles and boulders.

## T. 22 N., Sec. 18

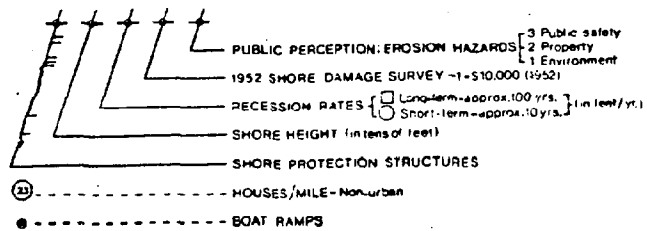
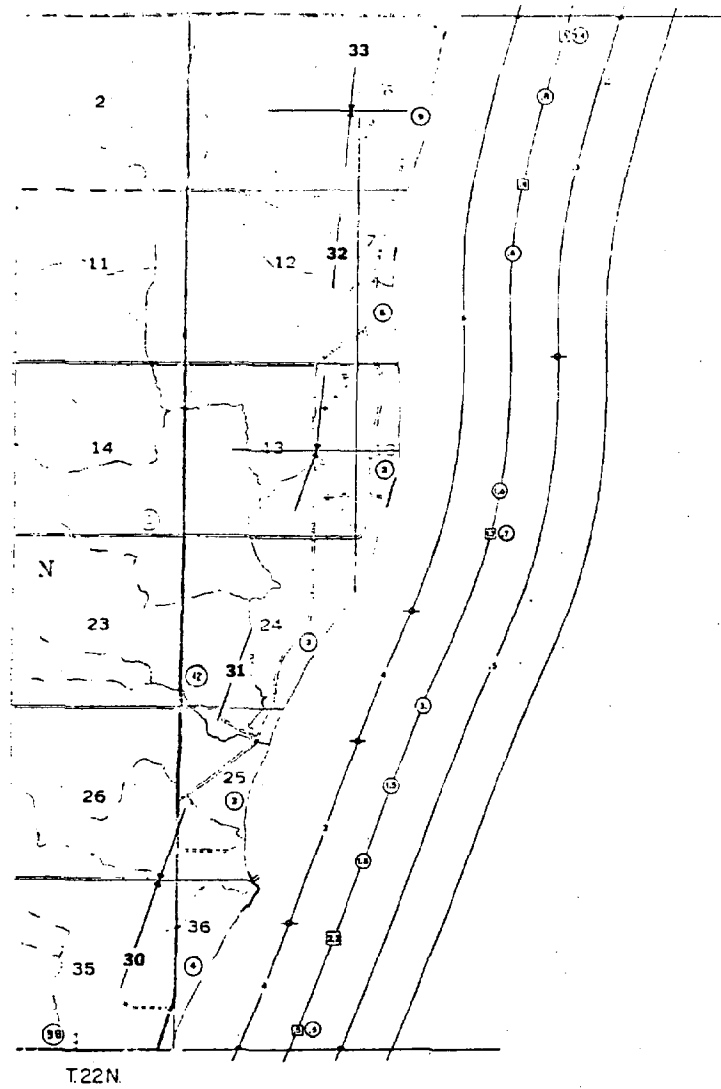
Section 18 (a) contains bluffs 60 to 80 feet high. The bluffs are generally about 50 percent vegetated with some small areas being up to 90% vegetated. Stratigraphy is fairly uniform throughout the section and consists of 0 to 4 feet of Two Rivers till overlying 10 to 40 feet of sand with occasional interbedded silt. This overlies 20 to 35 feet of gray silt and clay enclosing Haven till. At the base of the bluffs about 20 feet of clay till (Ozaukee) with boulders crops out.

The beach is 5 to 20 feet wide and made of sand. In the central and northern parts of the section boulders are abundant on the beach and offshore. In several places offshore a rock pavement has developed which appears to protect the bluff somewhat.

## T. 22 N., Sec. 7

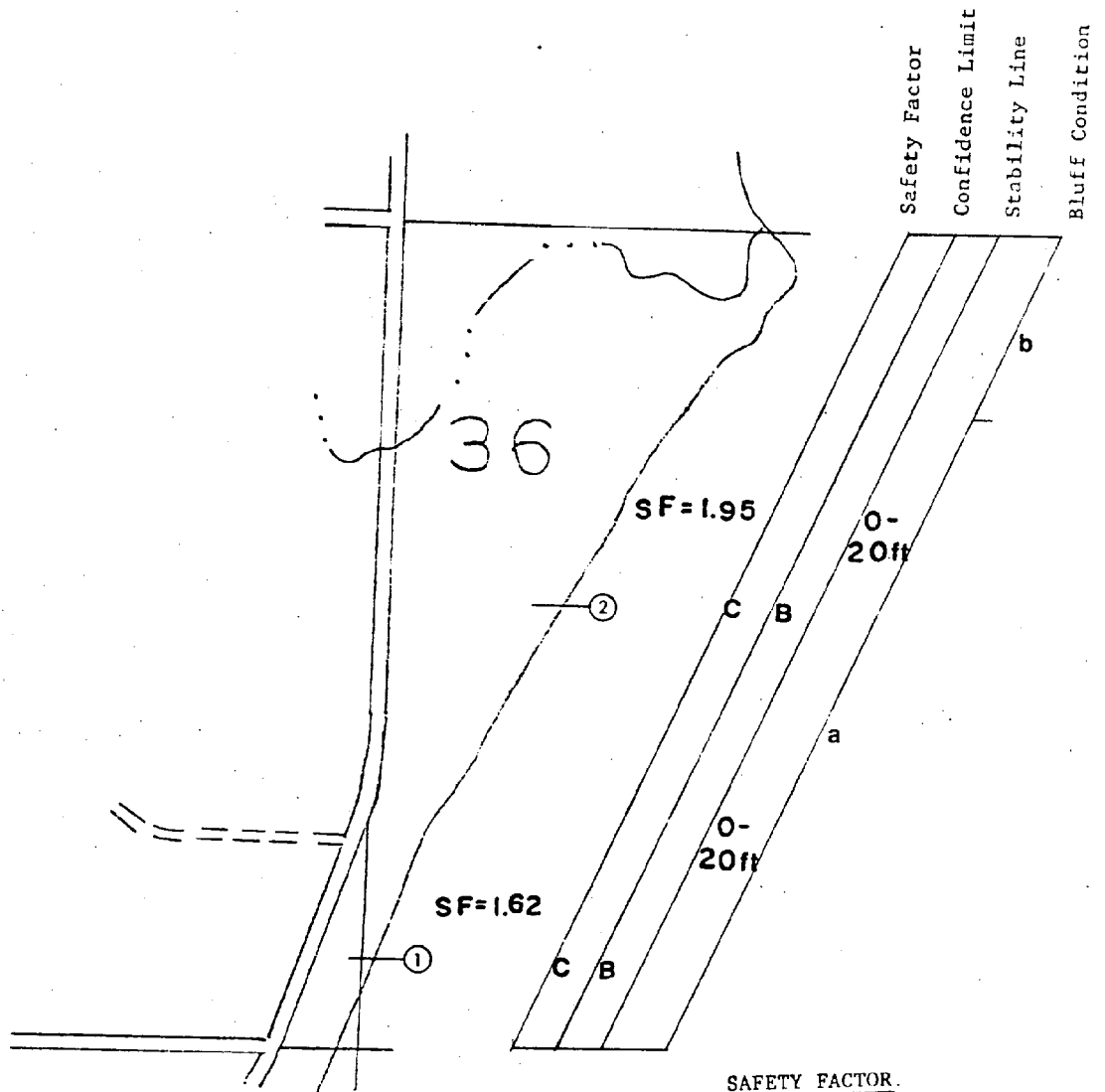
Section 7 (a) consists of bluffs 45 to 90 feet high. Vegetation cover varies from 10 to 80 percent. In most of the section the lower half of the bluffs are covered by debris from shallow slides and small slumps. Near 7.7 there are some larger rotational blocks. Stratigraphy is uniform throughout the section and consists of 4 to 6 feet of Two Rivers till overlying 3 to 20 feet of sand over 10 feet of Haven till unit. Below this till lies a 10-to-15 foot thick sequence of lacustrine silts and clays which overlies about 10 feet of Ozaukee till which crops out near the toe of the bluffs.

The beach ranges from 5 to 20 feet wide and consists of sand and pebbles to the south and sand, cobbles and dolomite boulders to the north of the section.



T. 211, R. 24E  
 100-0000

35



#### SAFETY FACTOR.

A-less than 1.00

B-1.00 to 1.25

C-greater than 1.25

#### CONFIDENCE LEVEL

A-boreholes

(high confidence)

B-near boreholes

stratigraphy visible

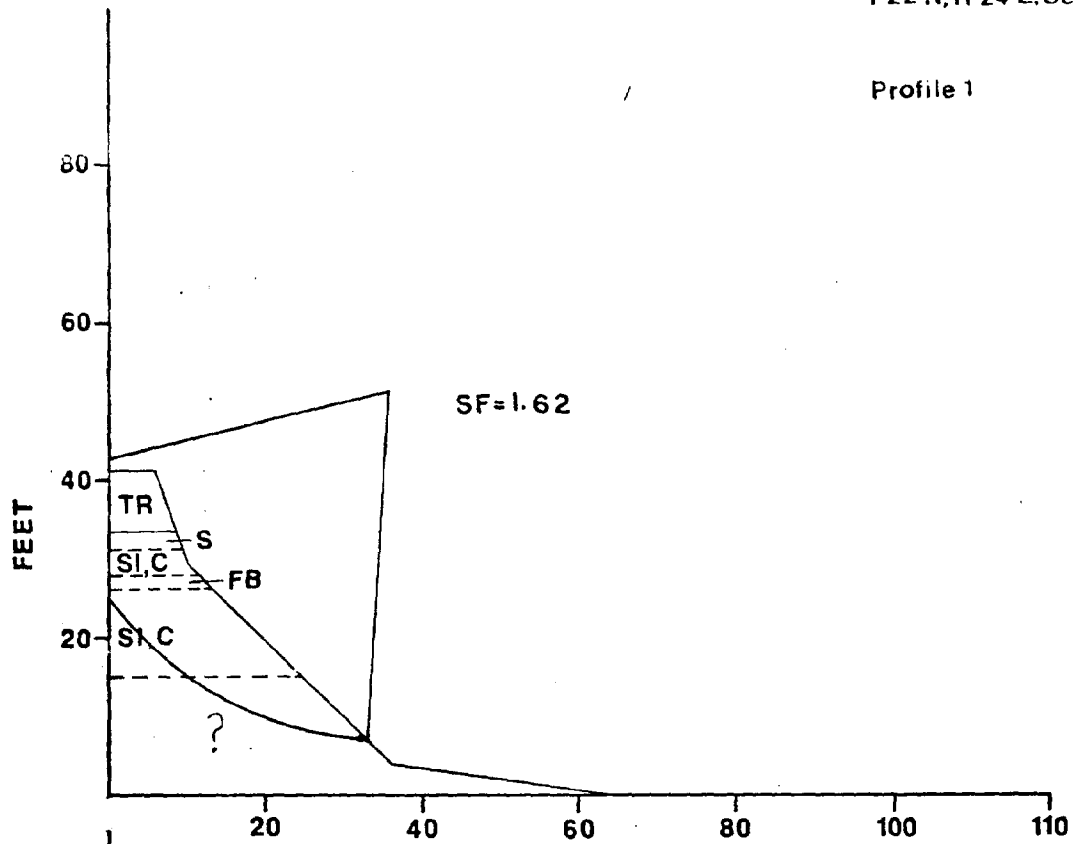
C-no stratigraphy

visible (low

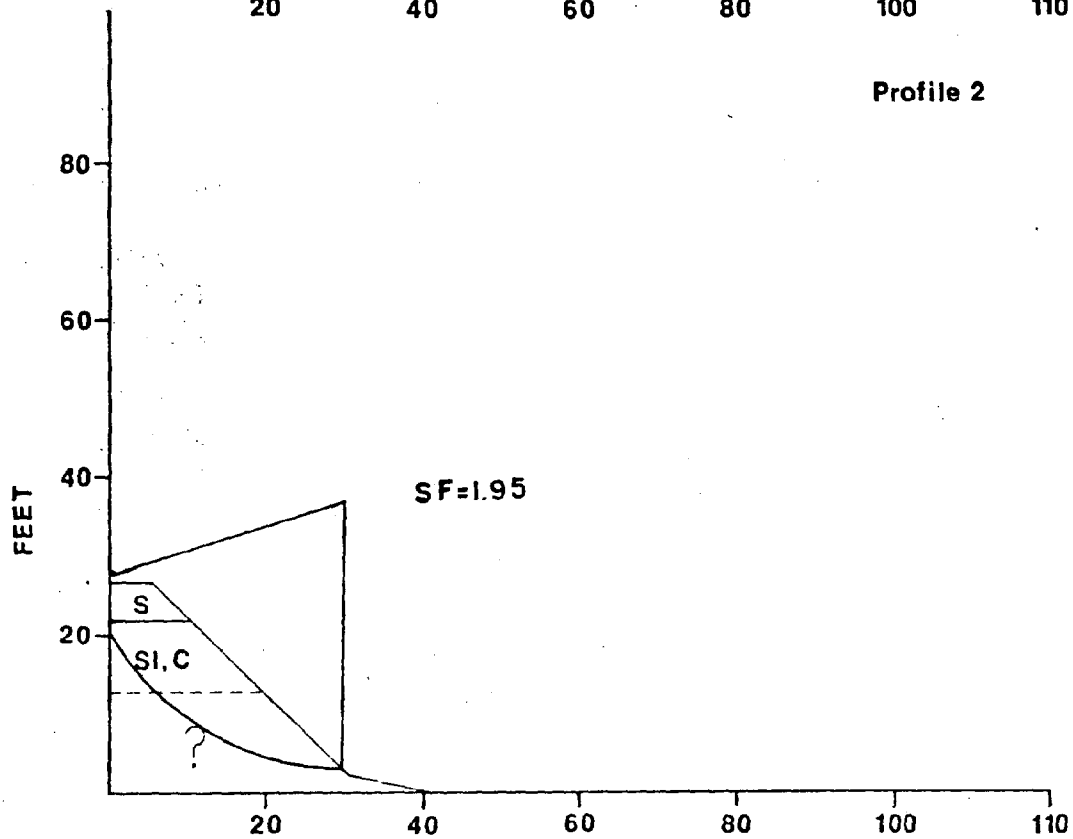
confidence)

T 22 N, R 24 E, Sec. 36

Profile 1

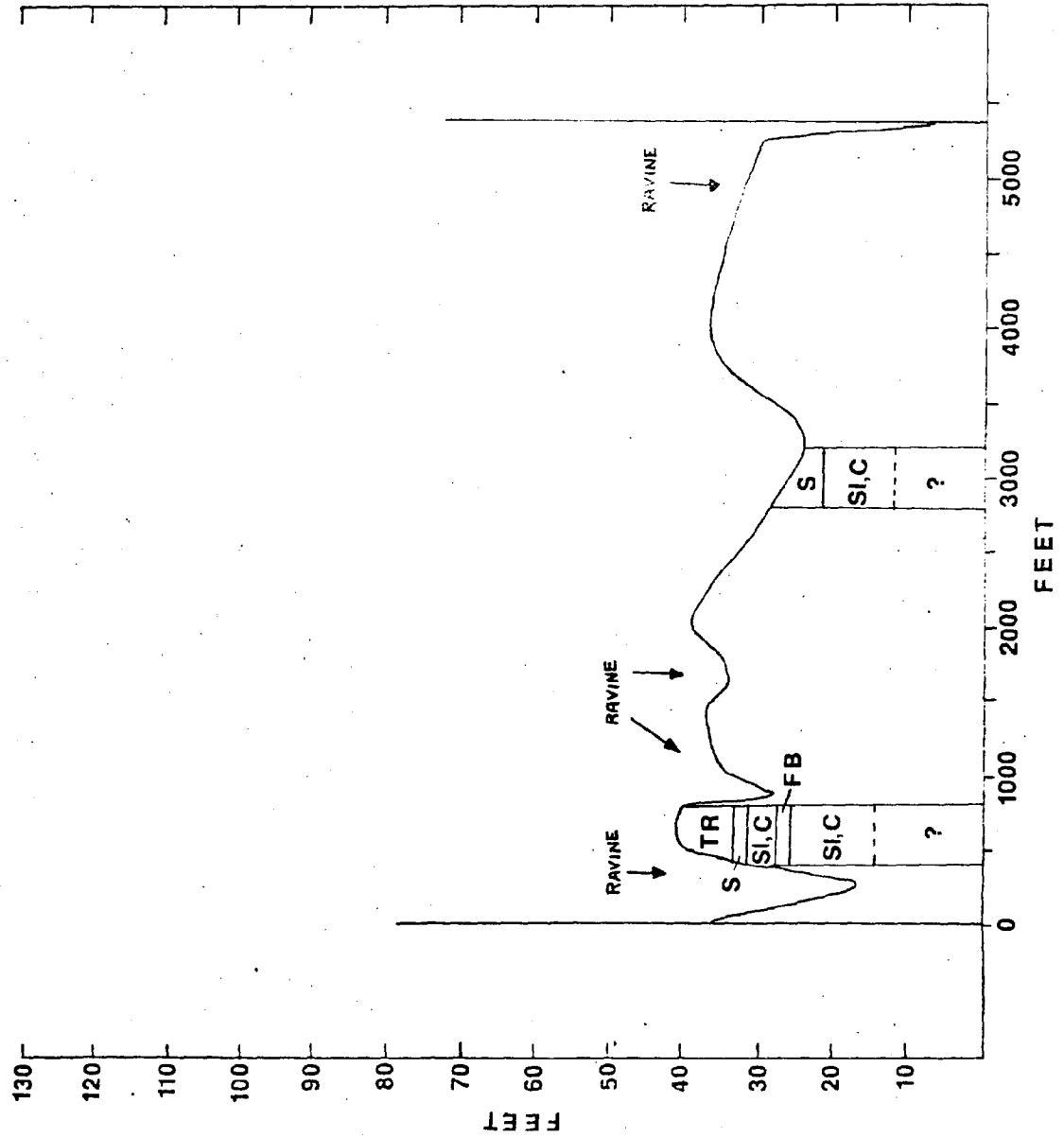


Profile 2

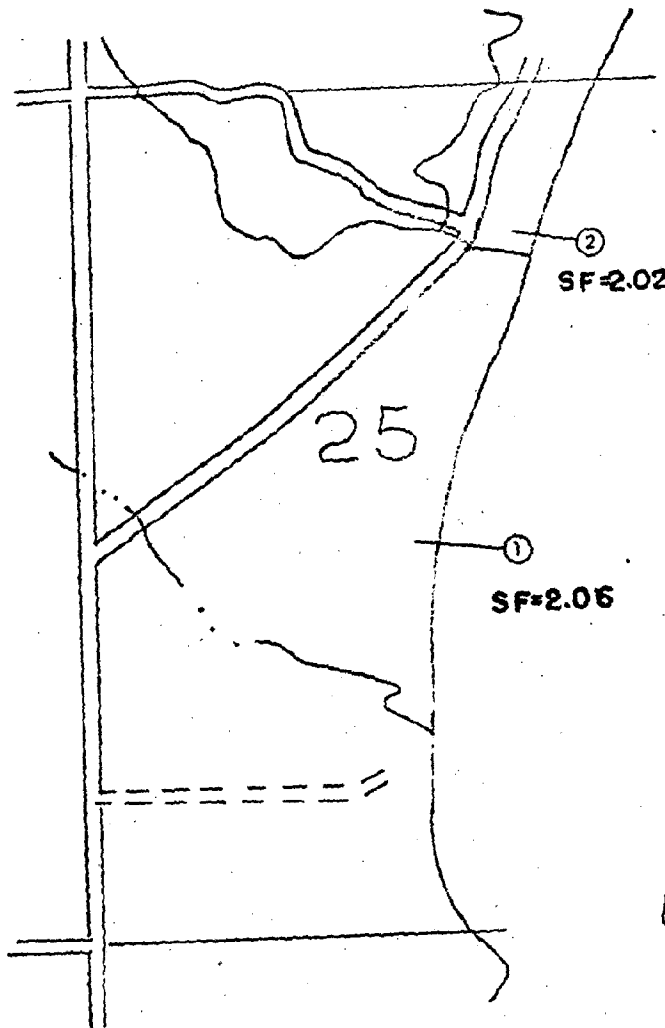




T22N R24E SEC. 36



T.22 N. R.24 E  
(KIEWITZ)



| Safety Factor | Confidence Limit | Stability Line | Bluff Condition |
|---------------|------------------|----------------|-----------------|
| C             | B                | 0-20ft         | b               |
| C             | B                | 0-20ft         | a               |

SAFETY FACTOR.

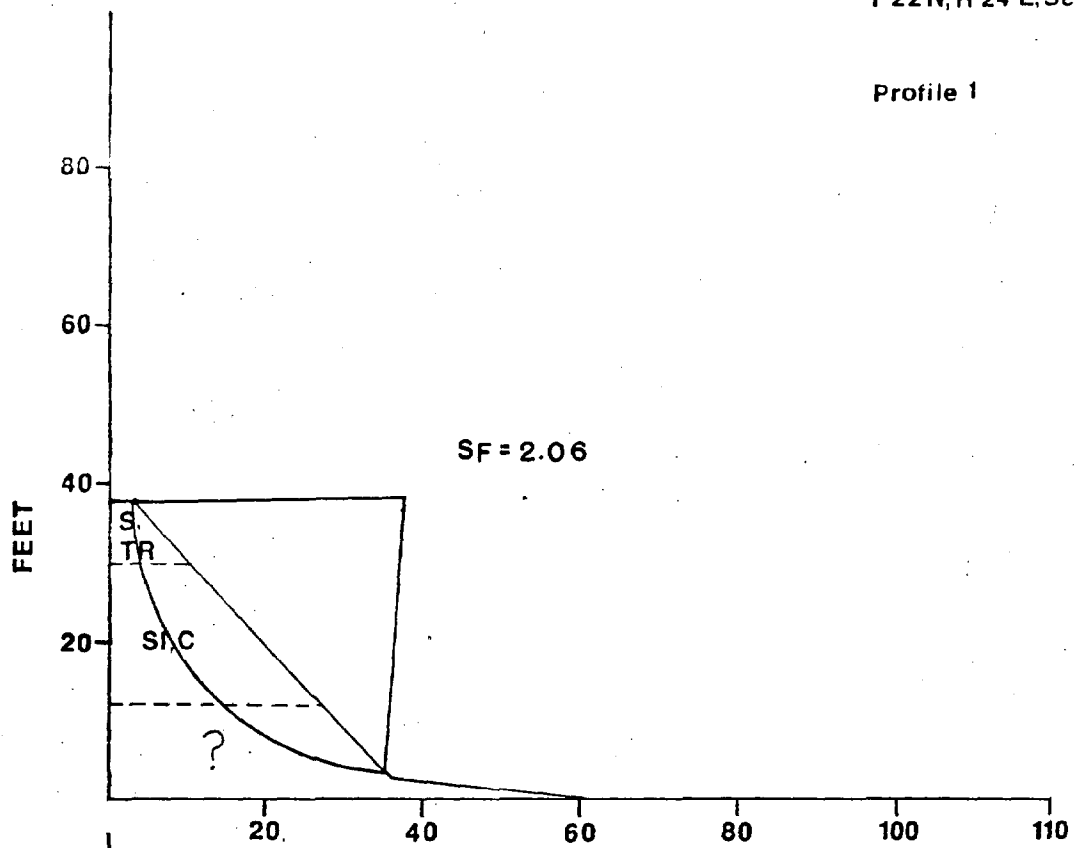
- A-less than 1.00
- B-1.00 to 1.25
- C-greater than 1.25

CONFIDENCE LEVEL

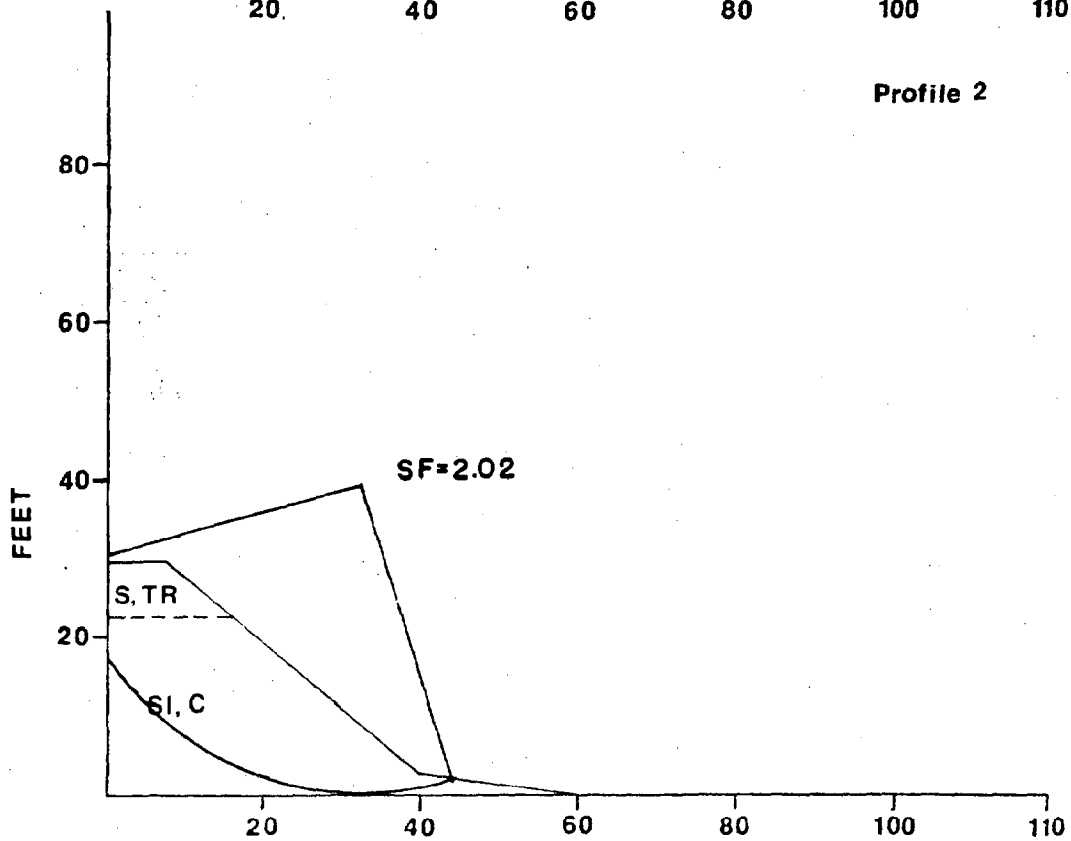
- A-boreholes (high confidence)
- B-near boreholes stratigraphy visible
- C-no stratigraphy visible (low confidence)

T 22 N, R 24 E, Sec. 25

Profile 1



Profile 2





T. 22 N, E. 18 E.  
(Keweenaw)

SAFETY FACTOR

A-less than 1.00

B-1.00 to 1.25

C-greater than 1.25

CONFIDENCE LEVEL

A-boreholes

(high confidence)

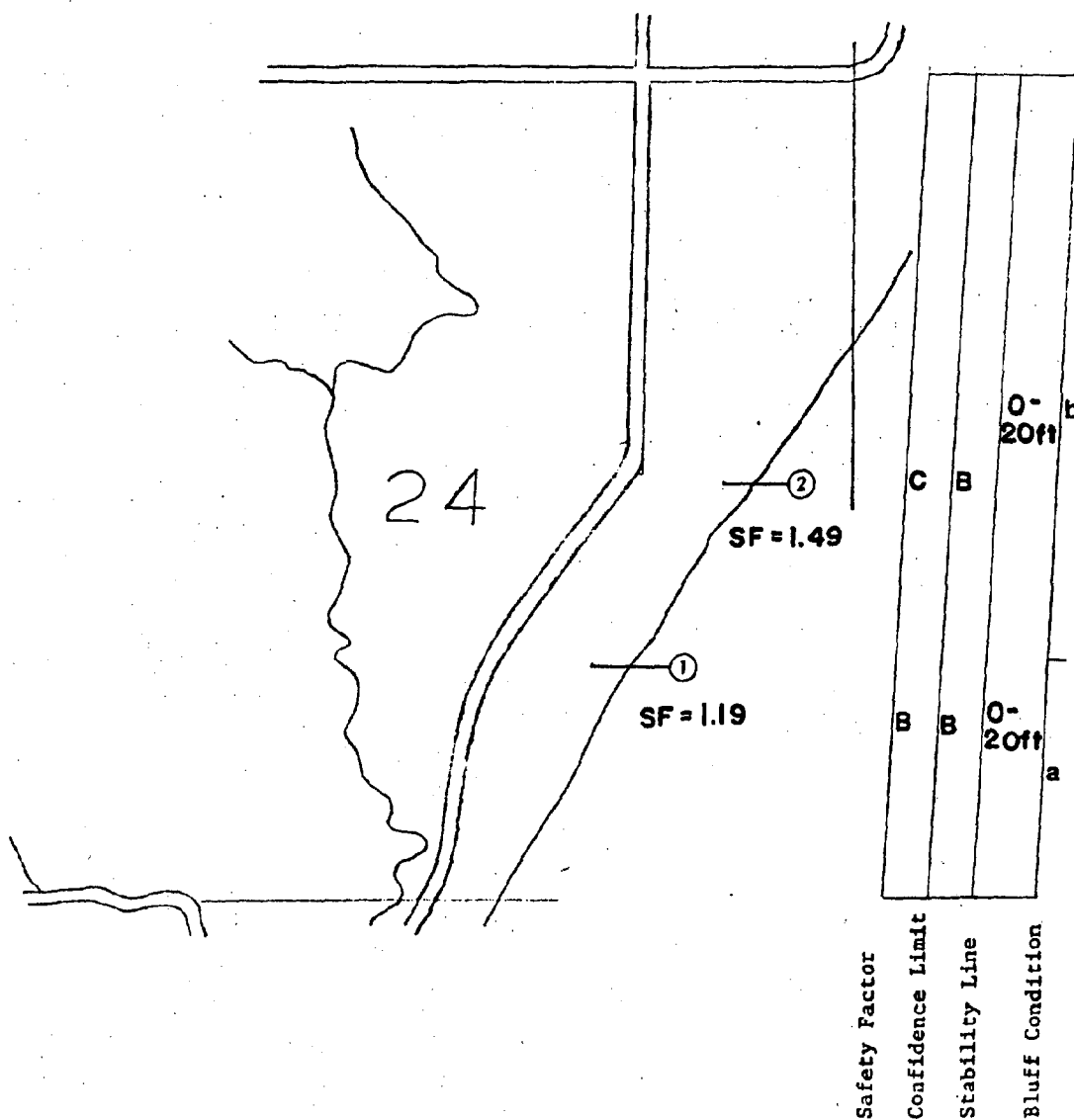
B-near boreholes

stratigraphy visible

C-no stratigraphy

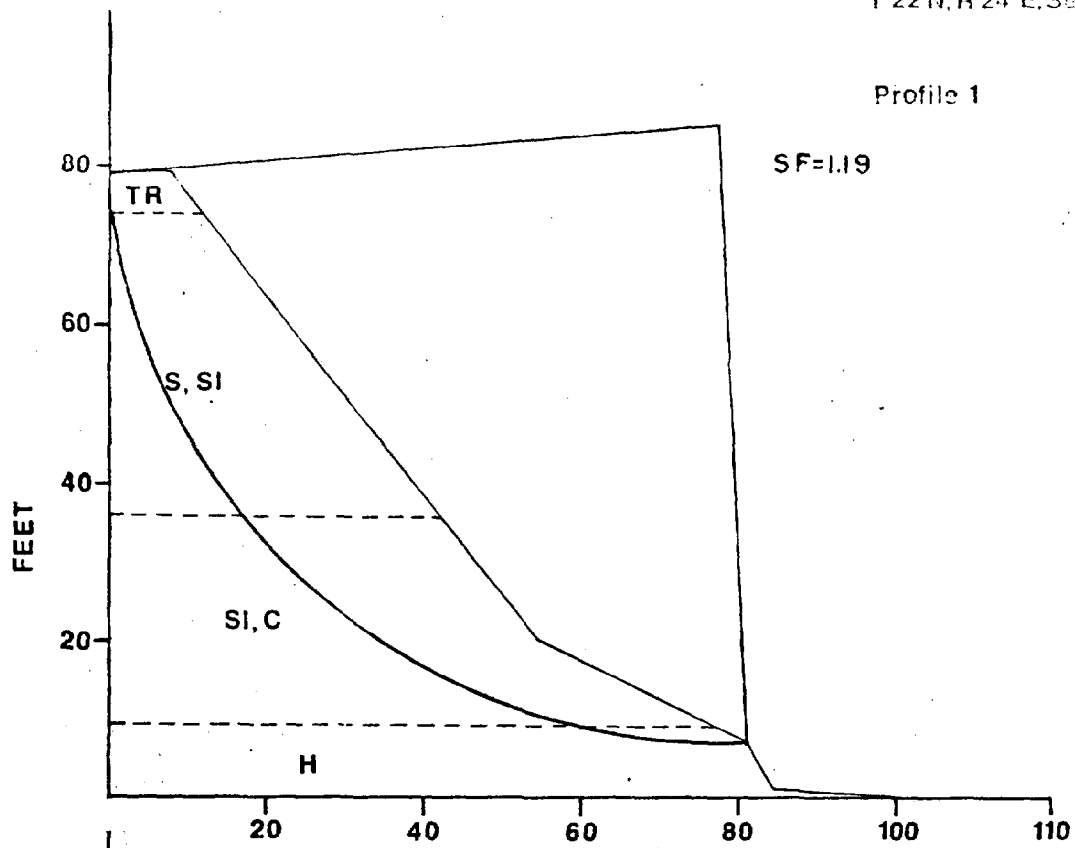
visible (low

confidence)

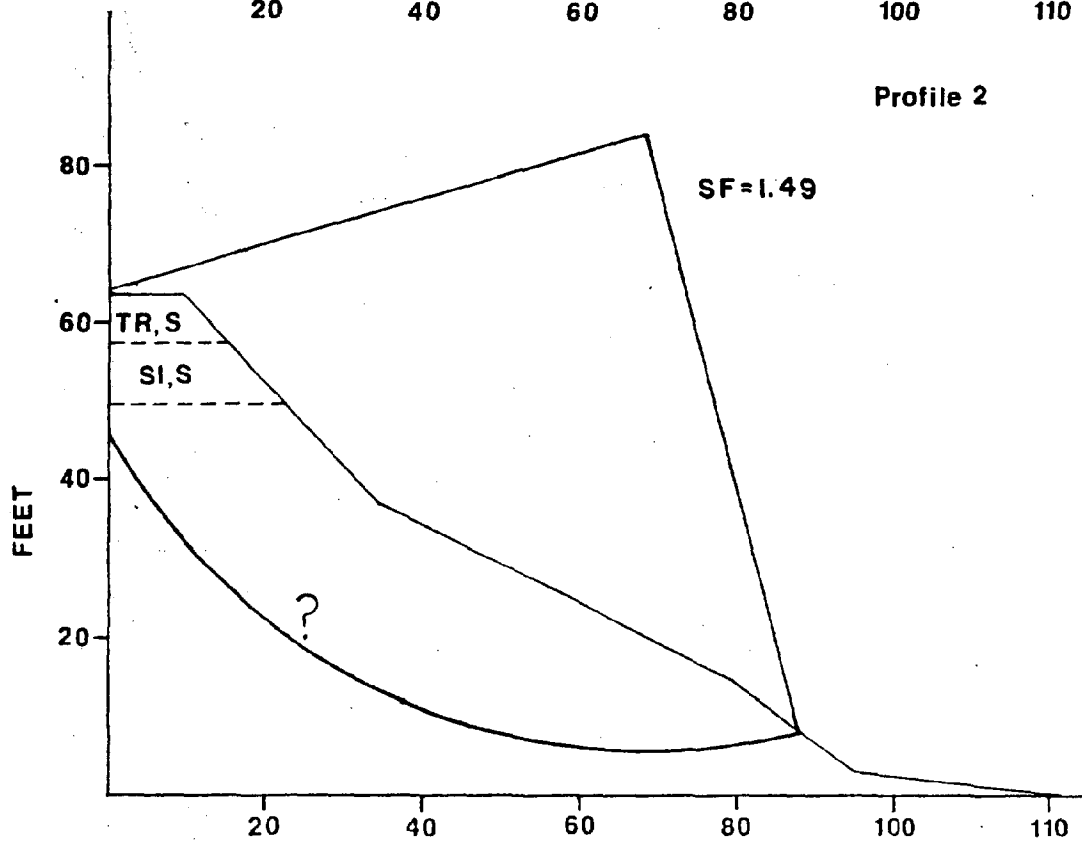


T 22 N, R 24 E, Sec. 24

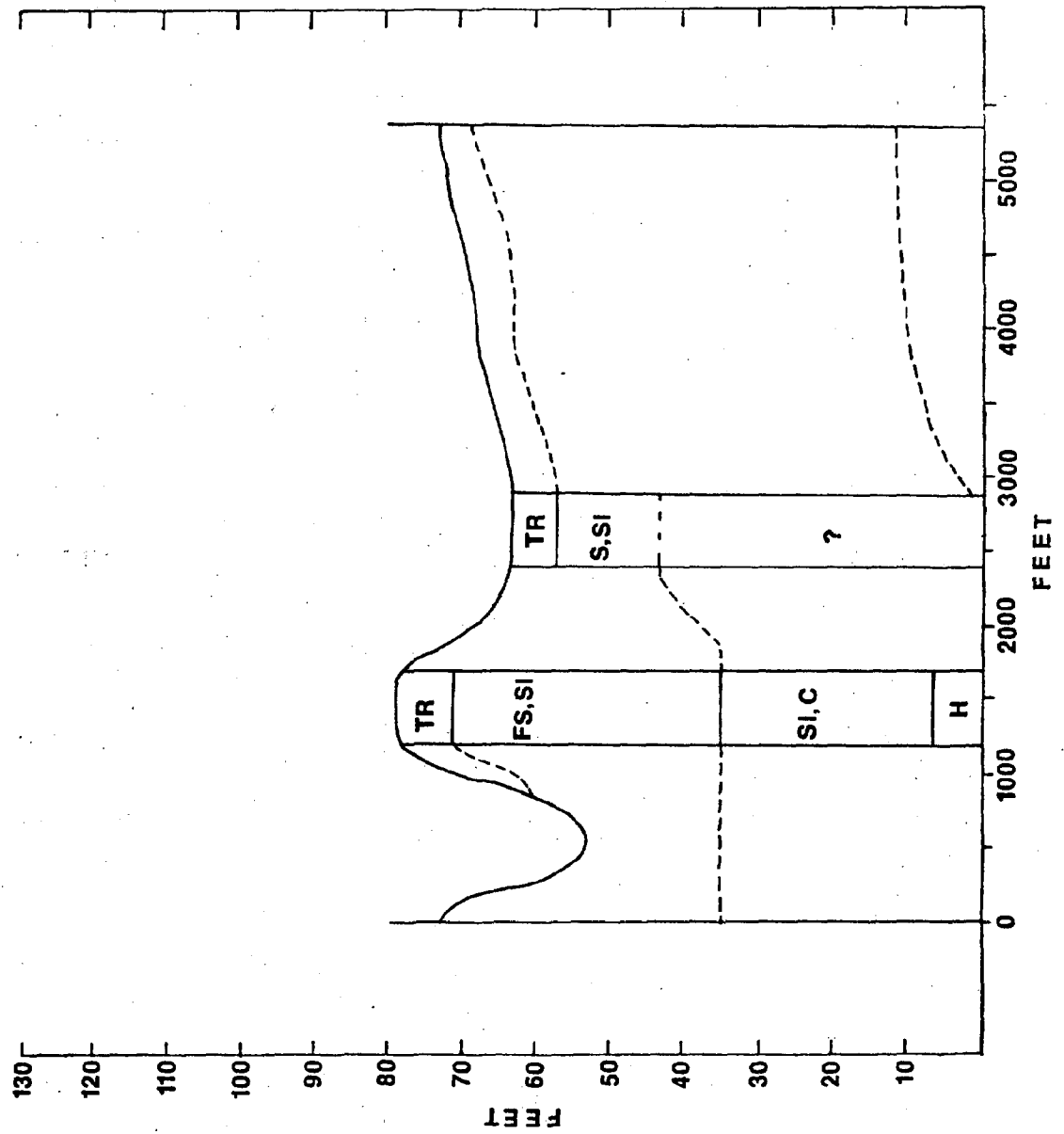
Profile 1



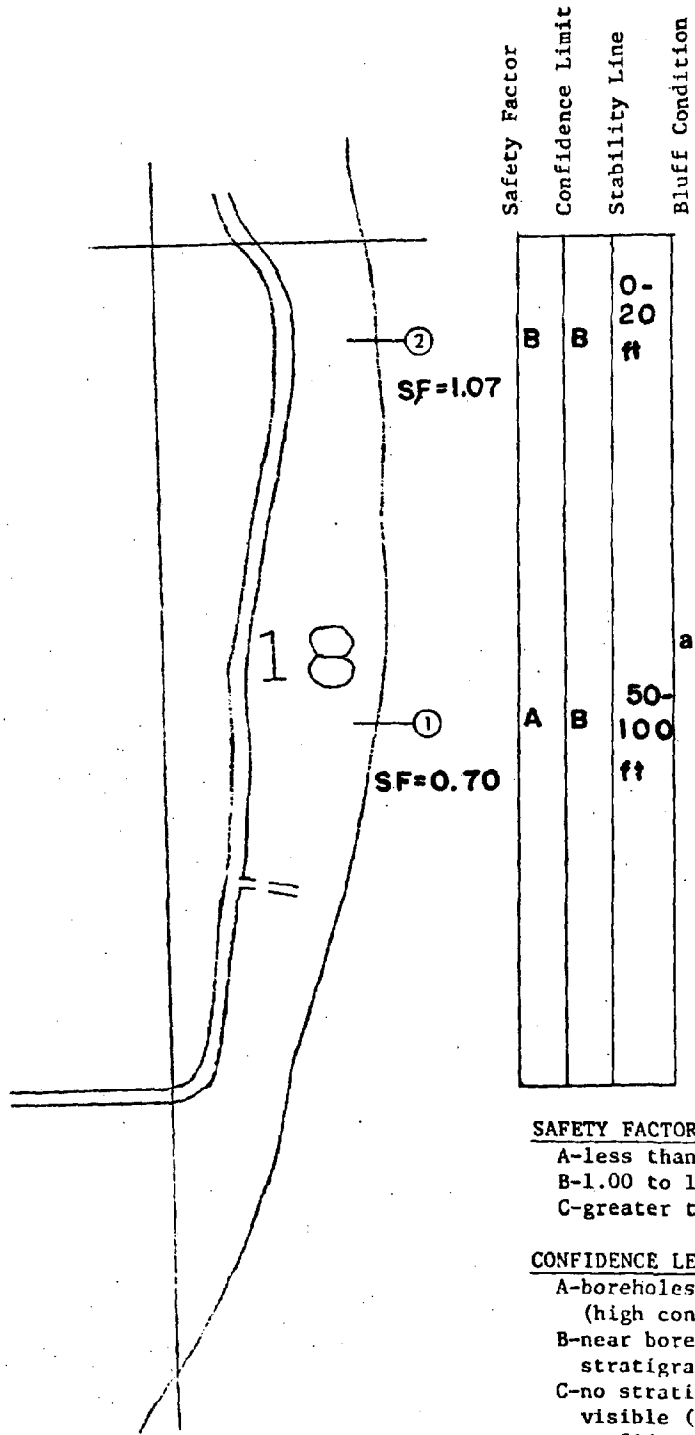
Profile 2



T22NR24E SEC.24



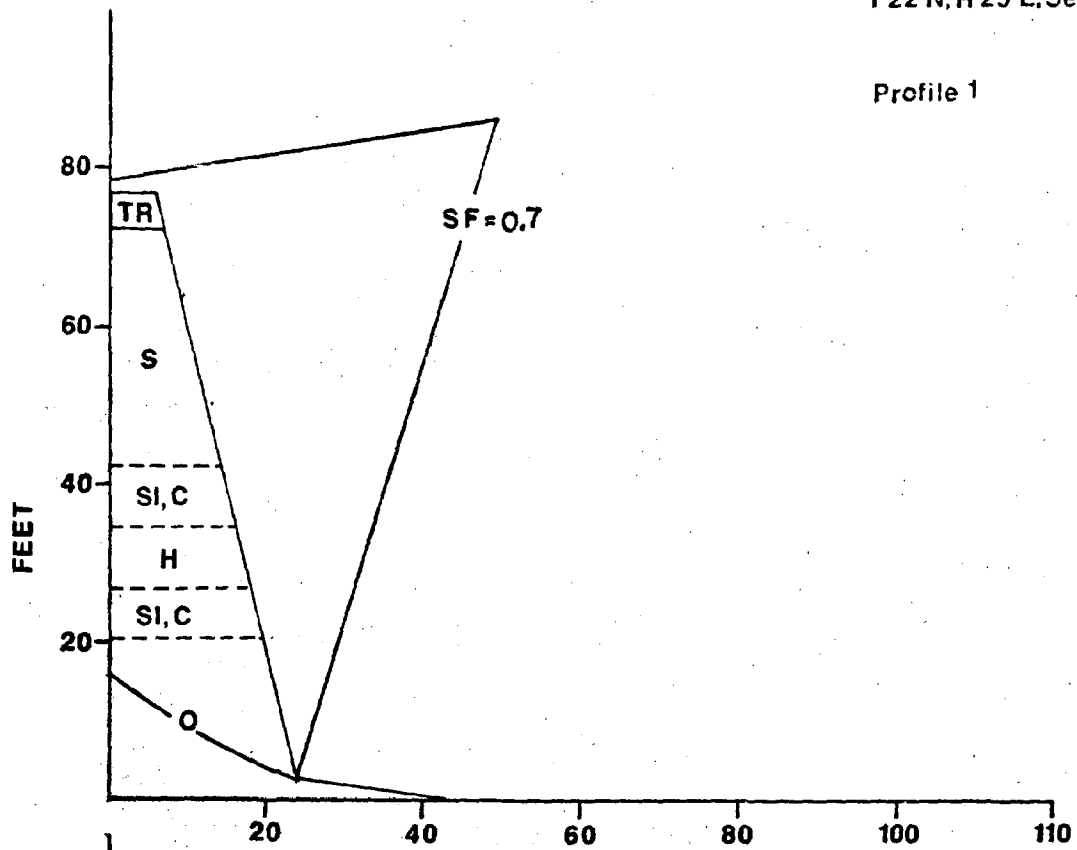
T122N, R11E L.  
(Continued)



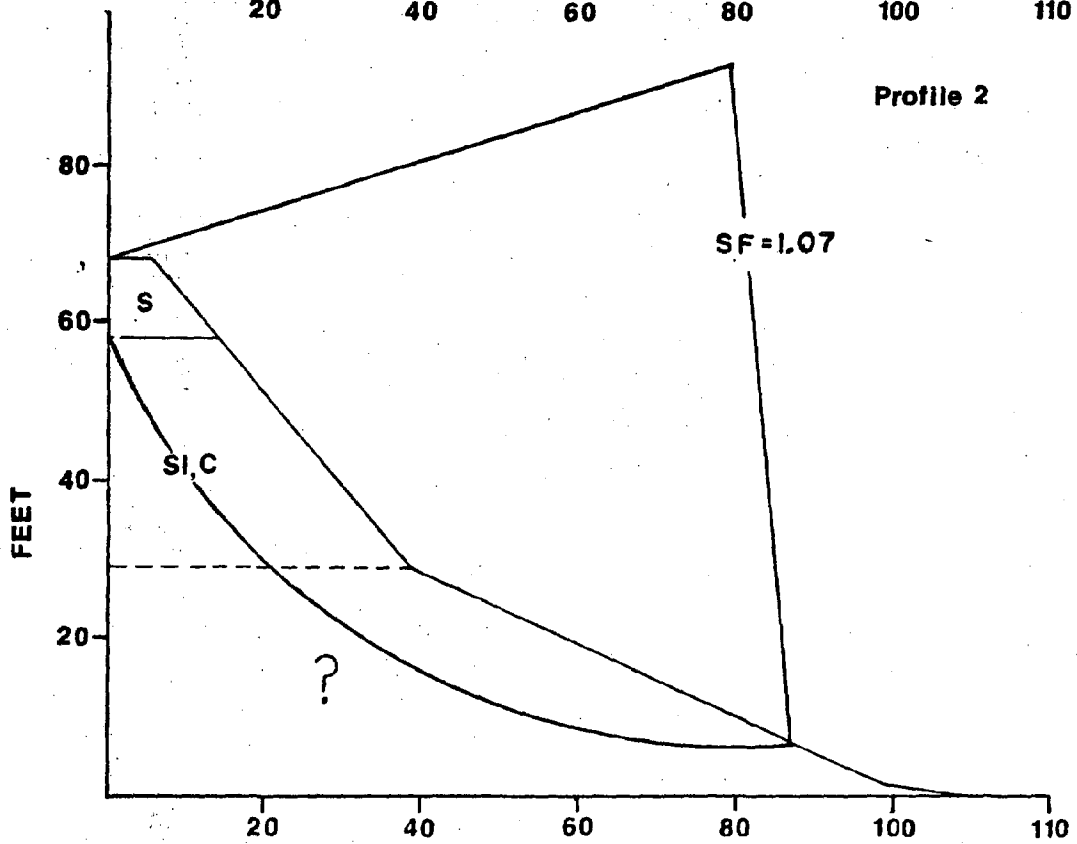


T22 N, R 25 E, Sec. 18

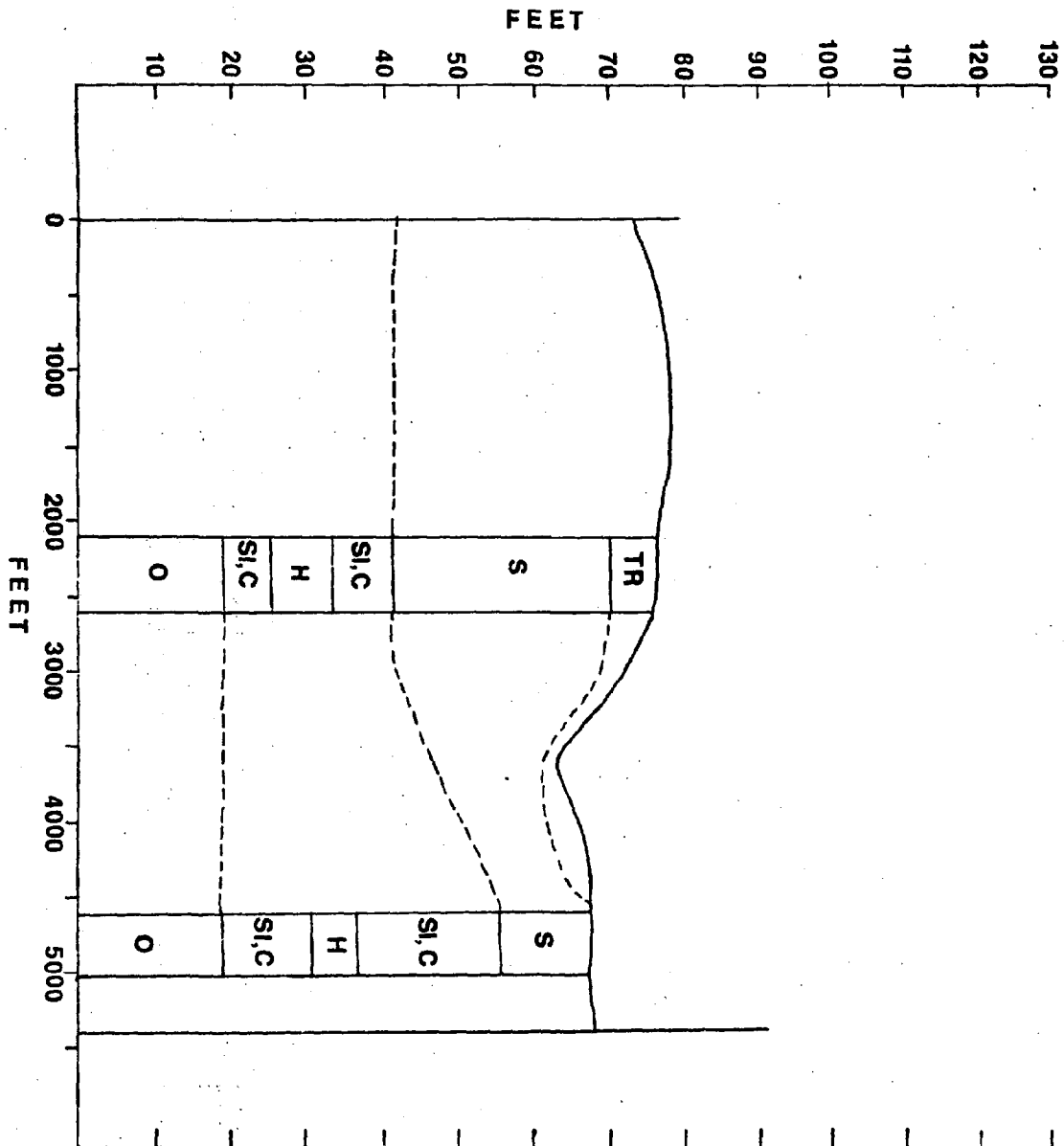
Profile 1



Profile 2



## T22N R25E SEC. 18

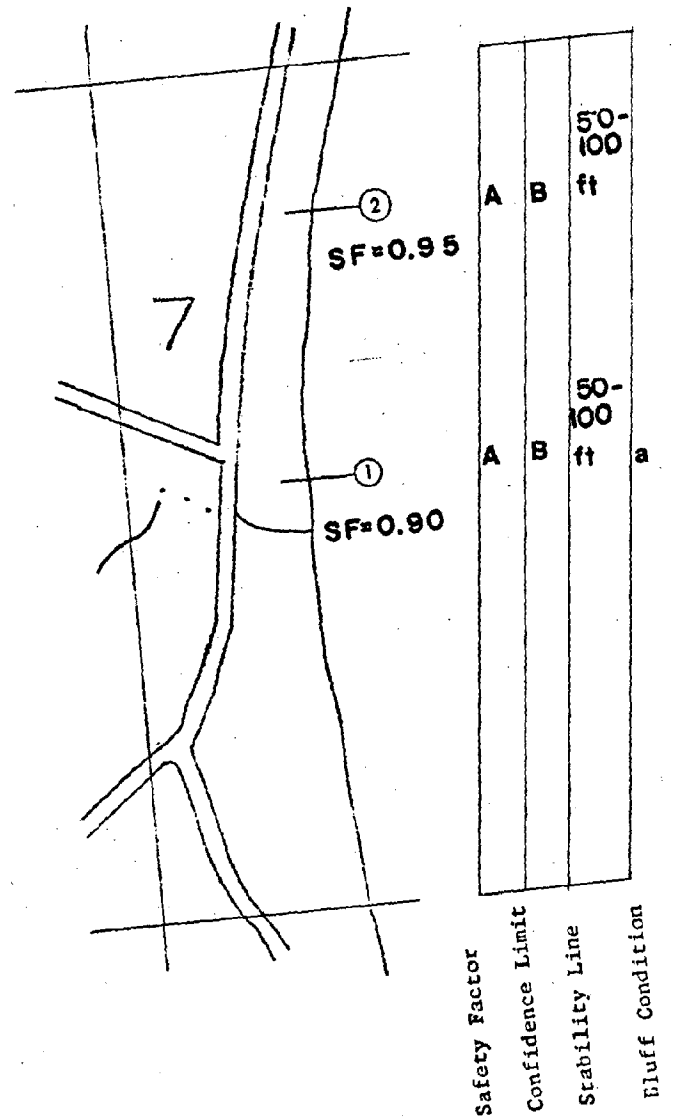


T-21-A, P-21-B

(100 ft x 100 ft)

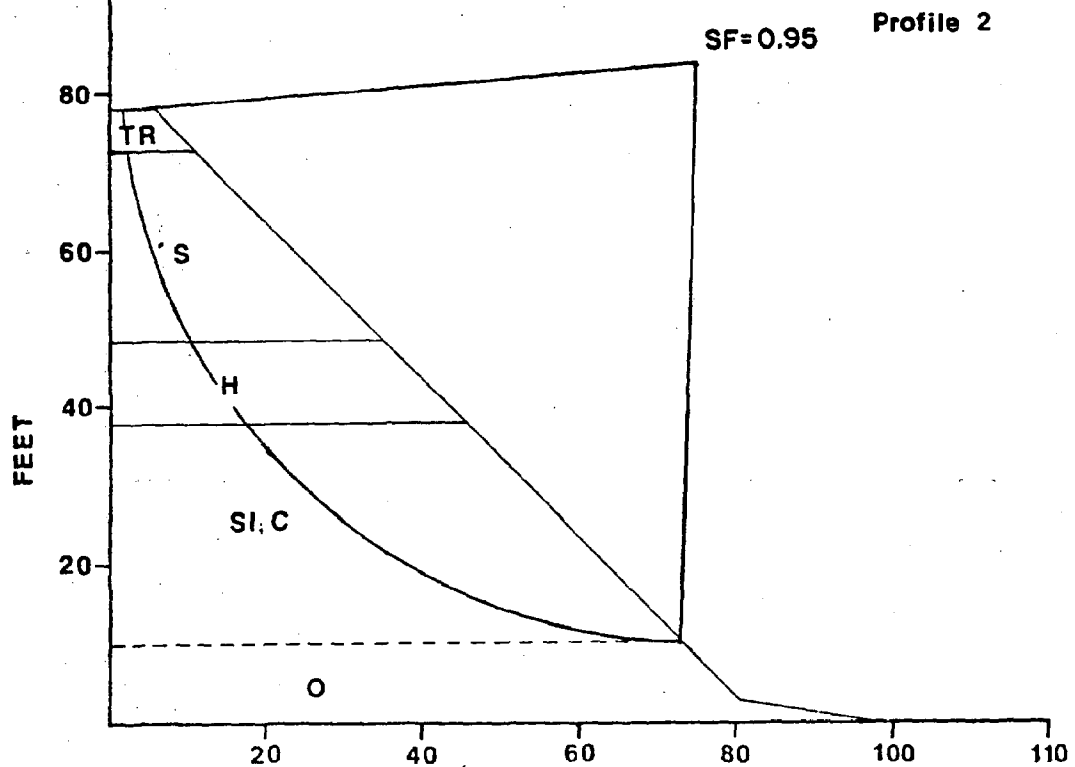
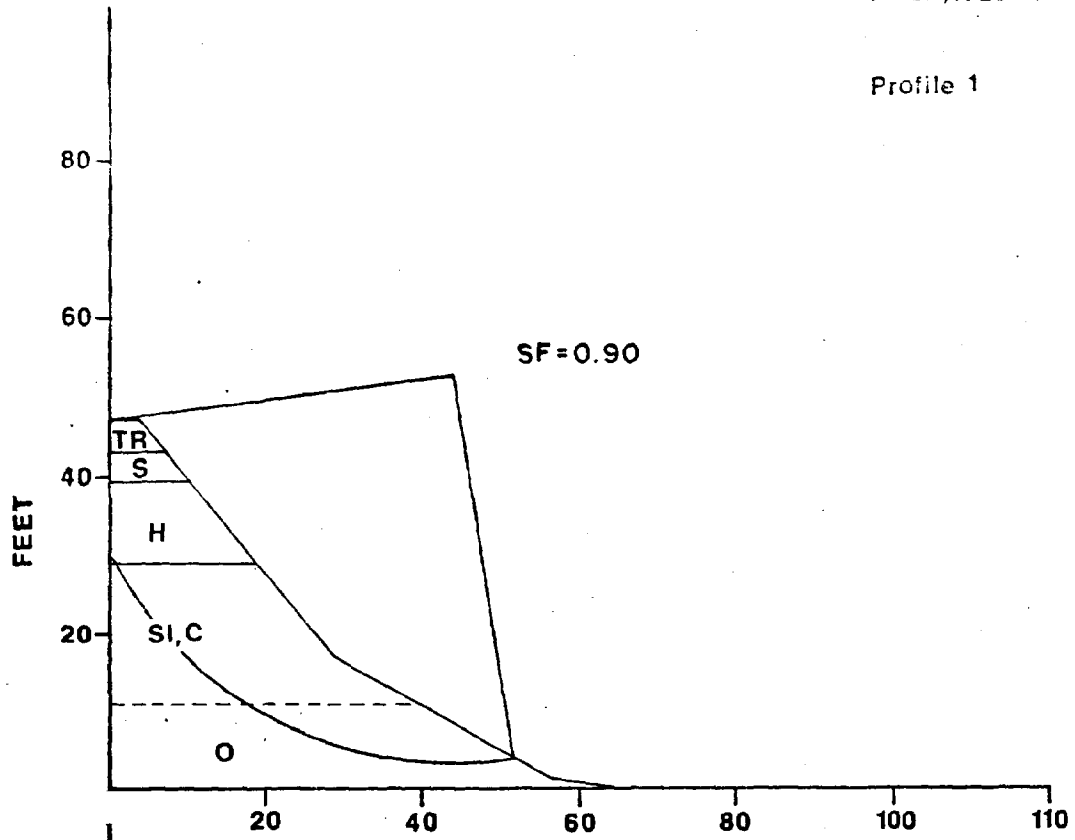
**SAFETY FACTOR**  
 A-less than 1.00  
 B-1.00 to 1.25  
 C-greater than 1.25

**CONFIDENCE LEVEL**  
 A-boreholes  
 (high confidence)  
 B-near boreholes  
 stratigraphy visible  
 C-no stratigraphy  
 visible (low  
 confidence)

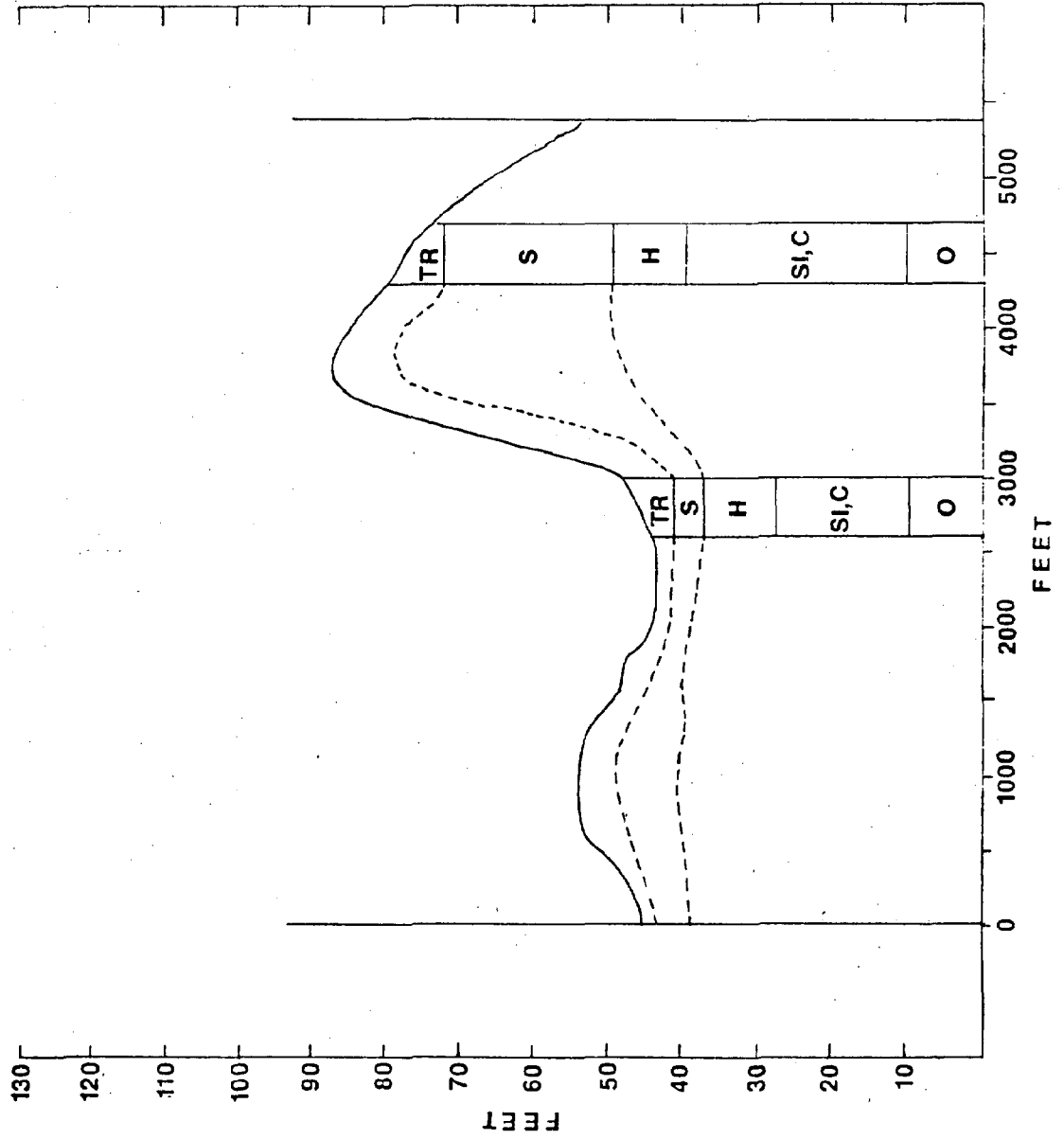


T 22N, R 25 E, Sec. 7

Profile 1



T22NR255 SEC.7



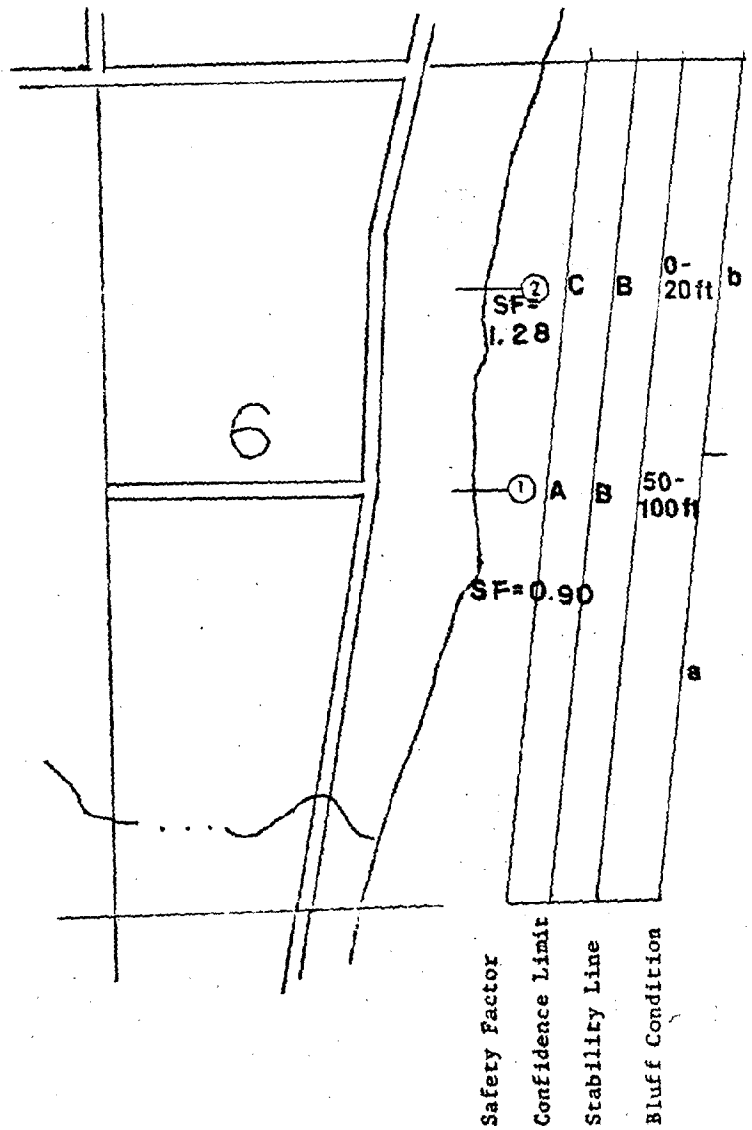
T 22N, R25E  
(KEWAUNEE)

SAFETY FACTOR

A-less than 1.00  
B-1.00 to 1.25  
C-greater than 1.25

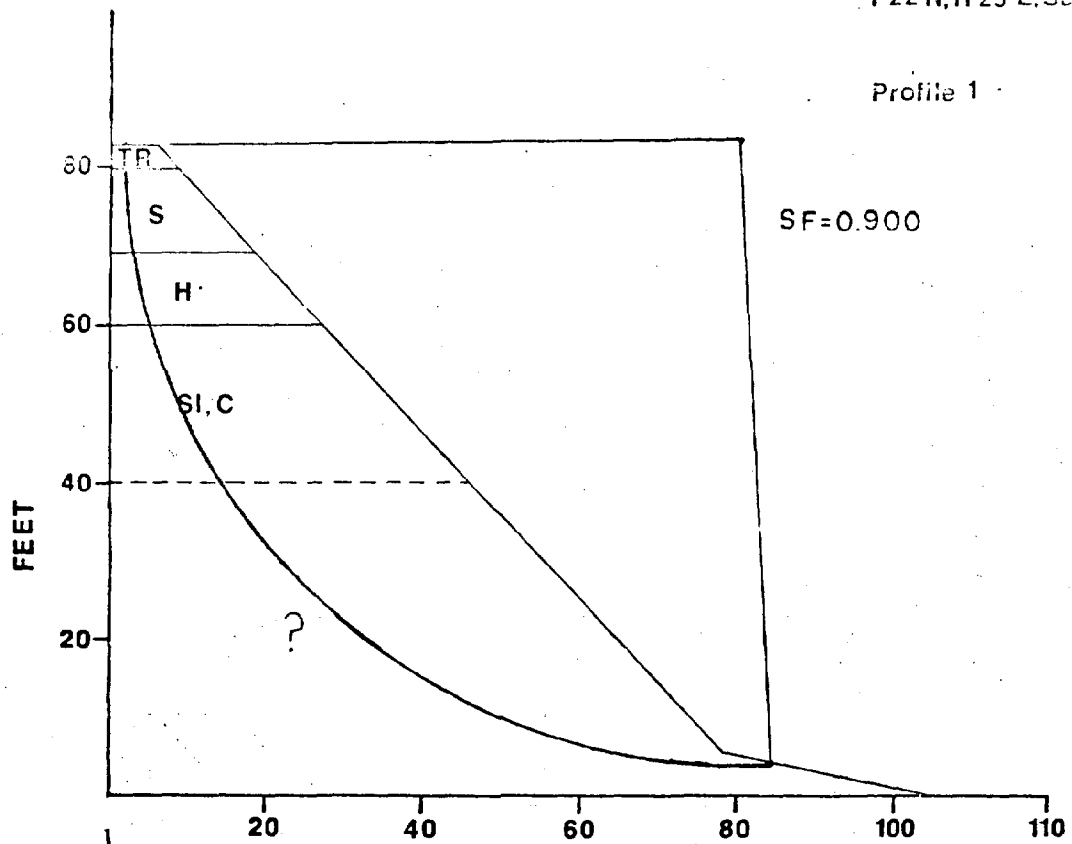
CONFIDENCE LEVEL

A-boreholes  
(high confidence)  
B-near boreholes  
stratigraphy visible  
C-no stratigraphy  
visible (low  
confidence)

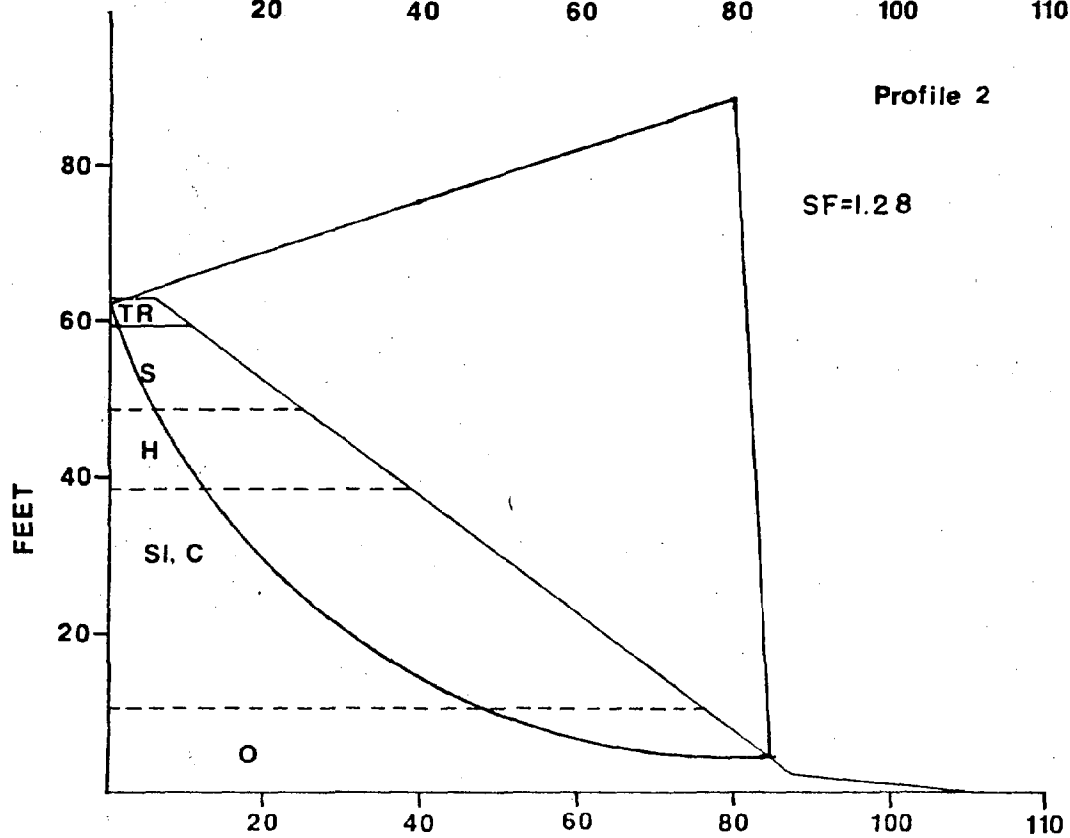


T 22 N, R 25 E, Sec. 6

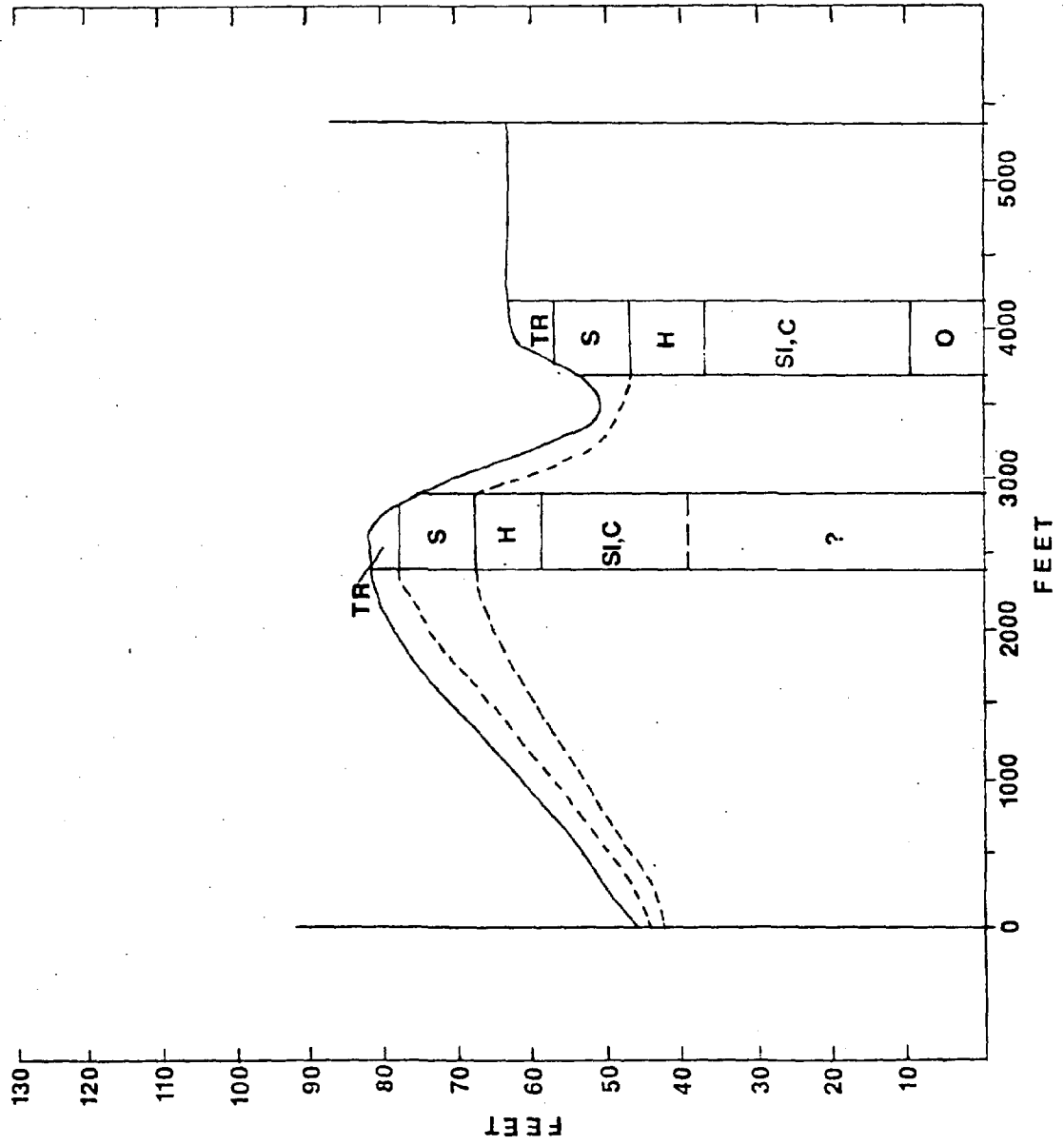
Profile 1



Profile 2



T22N, R25E, SEC. 6





T. 23 N., R. 25 E.

## T. 23 N., Sec. 31

Section 31 can be divided into two parts. The southern three-fourths (a) contains bluffs 70 to 90 feet high. The bluffs are approximately 50 percent vegetated and are failing by shallow slides and some small slumps. The bluffs are capped by 5 to 10 feet of clayey Two Rivers till. This is underlain by sand and silt with fine sand layers about 20 feet thick. Beneath this lies a second till unit (the Haven till) about 10 feet thick which overlies 15 to 20 feet of silt and clay. The beach is less than 15 feet wide and is sand with concentrations of pebbles and cobbles on the small cusps.

The northern one-fourth of the section (b) contains bluffs less than 50 feet high, which are drained by a stream flowing parallel to the bluff. Although these bluffs are mostly covered by trees, slump blocks are numerous.

Stratigraphy is similar to that of the southern subsection, however, a third till unit (Ozaukee till?) crops right beneath the Haven till. The beach in this subsection is less than 10 feet wide and consists of sand with scattered boulders.

## T. 23 N., Sec. 30

Section 30 contains bluffs 50 to 80 feet high which are similar throughout the section (a). The bluff crest is smooth and rises steadily to the north. The slopes are 50 to 100 percent vegetated primarily with shrubs and trees. The bluffs are capped by 6 feet of Two Rivers till. This overlies a unit containing silt, sand and gravel which thickens from 10 feet at mid-section to 50 feet at the north section line. Slope failure is primarily by planar slides, but some medium-size slumps are present also.

The beach is generally 10 to 30 feet wide and made of sand with cobbles and boulders present offshore.

## T. 23 N., Sec. 19

Section 19 can be divided into three subsections. From the southern end of the section to 19.4 (a) the bluffs are 80 to 100 feet high. The slopes are 20 percent vegetated and are failing by shallow slides. Bluff stratigraphy at profile 1 consists of 6 to 10 feet of Two Rivers till over a discontinuous forest bed unit approximately 2 feet thick. This overlies 2 feet of sand and a 10 foot thick layer of Haven till. Beneath this lies 4 feet of gravel, the 10 foot thick Ozaukee till member, 2 feet of fine sand, and 10 feet of silt and clay. Near the base of the bluff is a fourth till unit tentatively identified as the Cary till. The beach is 15 to 30 feet wide and consists of sand with pebbles, cobbles and some boulders.

From 19.4 to 19.8 (b) the bluff is 90% vegetated and no sections are exposed. Bluff height decreases to the north where it becomes a low terrace and the beach widens to greater than 50 feet in this subsection.

From 19.8 to the north end of the section (c) there exists only a low terrace in front of which is a 50 foot wide sand beach. The section ends at the south edge of the harbor at Kewaunee.

## T. 23 N., Sec. 17

Section 17 is divided into two subsections. The southern one-half (a) contains the flooded mouth of the Kewaunee River and Kewaunee harbor. North of the mouth of the river 1/2 mile beach is protected by rip-rap. No bluff is present.

The northern one-half of section 17 (b) contains bluffs 40 to 50 feet high and is 0-10 percent vegetated. The dominant mode of failure is by shallow slides, although there are some headward eroding gulleys in the northern part of the subsection. The bluff stratigraphy generally consists of 5 to 10 feet

of Two Rivers till overlying 5 to 10 feet of Haven till. This overlies a complex sequence of sand and gravel and silt layers 10 feet thick which are over a gray, sandy till which is unidentified. The lower one-half to one third of the bluff is covered by debris and obscured. The beach is 5 to 15 feet wide and consists of sand with pebbles except the middle one-third of the subsection which consists of cobbles with occasional boulders.

T. 23 N., Sec. 8

Section 8 contains bluffs 40 to 50 feet high. The crests are fairly uniform except where two streams have cut down through the bluff. The middle one-third of the section is 10 to 100 percent vegetated with herbs, shrubs and trees while the remainder is 0 to 10 percent vegetated. The bluffs are capped by 4 to 8 feet of clayey Two Rivers till. The lower part of the unit differs in color but is similar in texture to the Upper. Beneath this is generally 10 to 20 feet of gravel, sand, silt and clay layers, however, in the northern third of the section a reddish-brown till unit (Haven) 10 to 15 feet thick crops out beneath the upper till. The lower one-half to one-third is covered by debris.

The dominant mode of bluff failure is shallow slides, although small slump block failures are present in the northern one-third of the section. The beach is 10 to 30 feet wide and consists of pebbles and cobbles to the south and pebbles with sand near the northern end of the section.

T. 23 N., Sec. 5

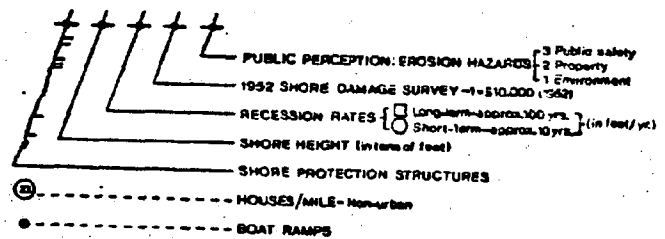
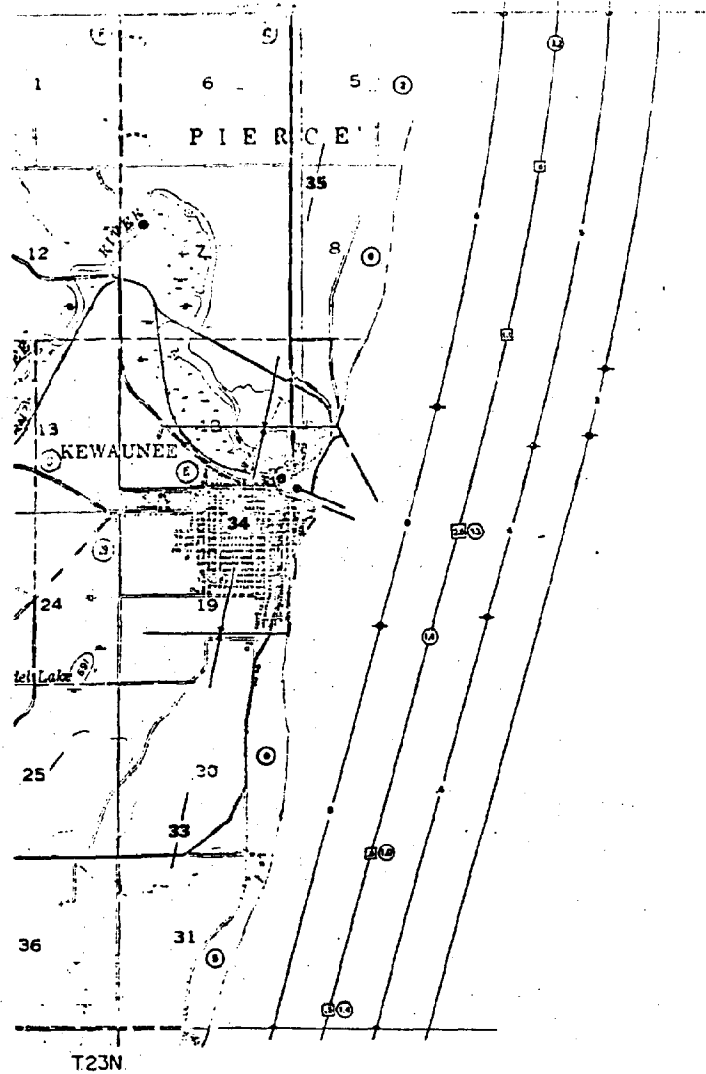
The bluff portion of section 5 is divided into three subsections. From 5.0 to 5.1 (a) the bluff is 40 to 50 feet high and is 10 to 20 percent vegetated. Medium-sized slump blocks are the dominant mode of failure. The upper half of the bluff consists of 2 to 4 feet of red till over 4 to 6 feet of red-brown till (all Two Rivers). This overlies 6 to 8 feet of Haven till which overlies

5 to 10 feet of sand and silt. The bottom half of the bluff is covered by slump material which obscures the stratigraphy.

From 5.1 to 5.6 (b) the bluffs are 40 to 50 feet high. Vegetation ranges from open slopes to 100% in deep ravines and near streams. Failure type is dominated by shallow slides and headward eroding gulleys. The stratigraphy is the same as the previous subsection.

From 5.6 to the end of the section (c) the bluff height drops to less than 12 feet. The low bluffs present are characterized by small slumps and slides. The balance of the subsection consists of a low, vegetated terrace.

The beach throughout section 5 is 5 to 30 feet wide and is made of sand with pebbles. Occasional cobbles are observed near the extreme south of the section.



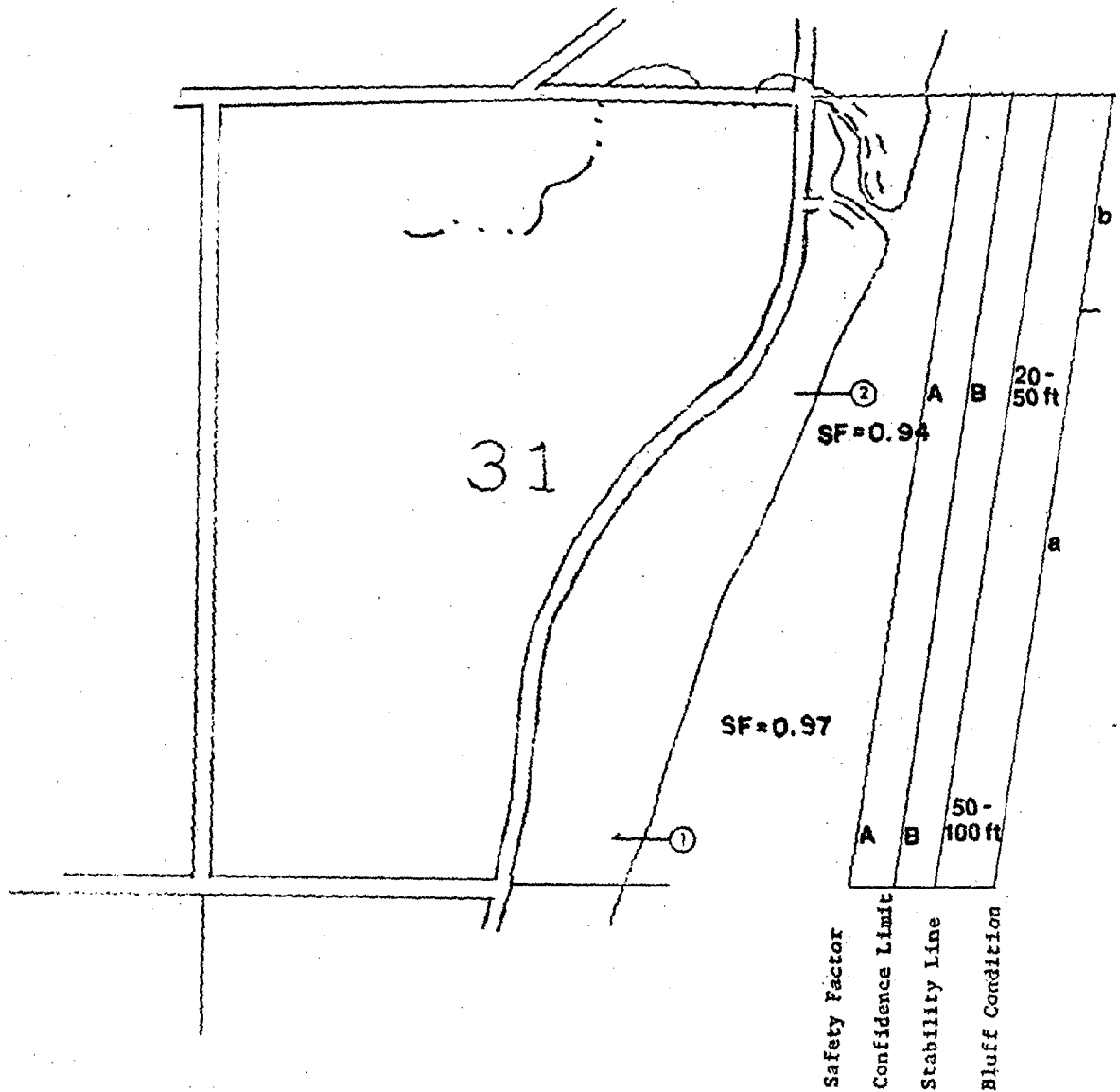
T. 23N, R. 23E  
(FLORIDA)

# SAFETY FACTOR

A-less than 1.00  
B-1.00 to 1.25  
C-greater than 1.25

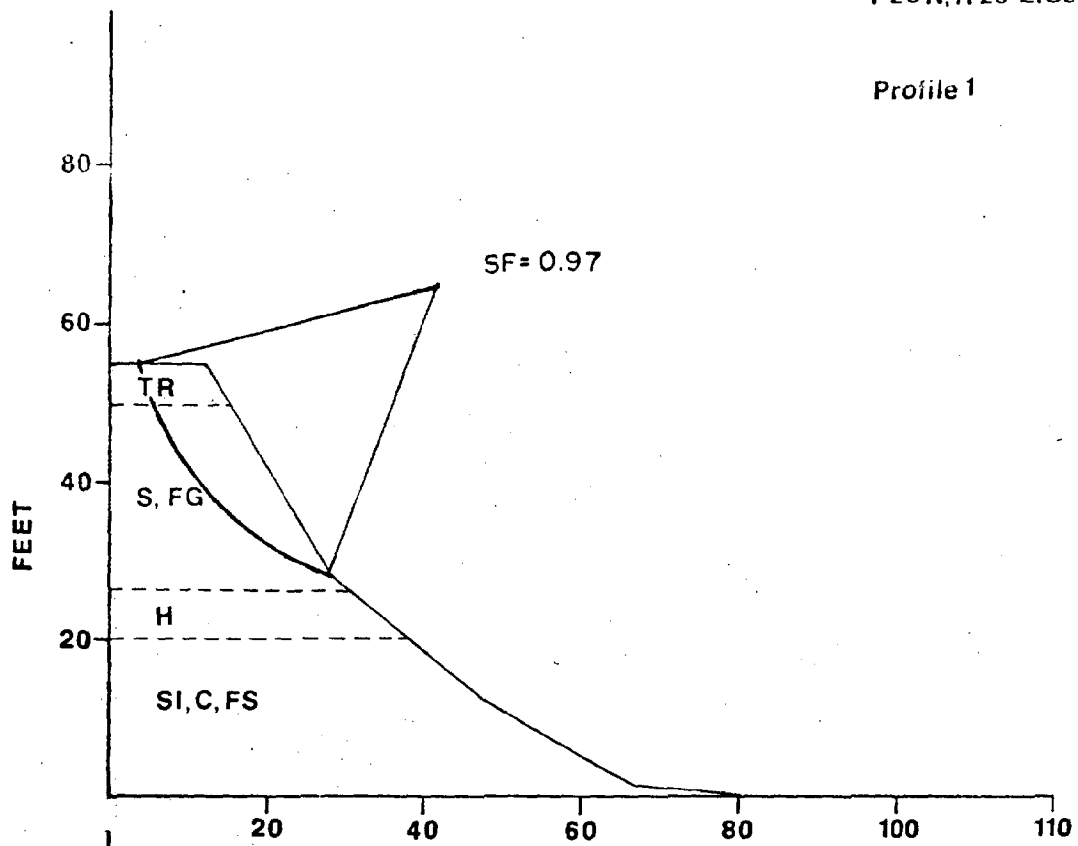
# CONFIDENCE LEVEL

A-boreholes  
(high confidence)  
B-near boreholes  
stratigraphy visible  
C-no stratigraphy  
visible (low  
confidence)

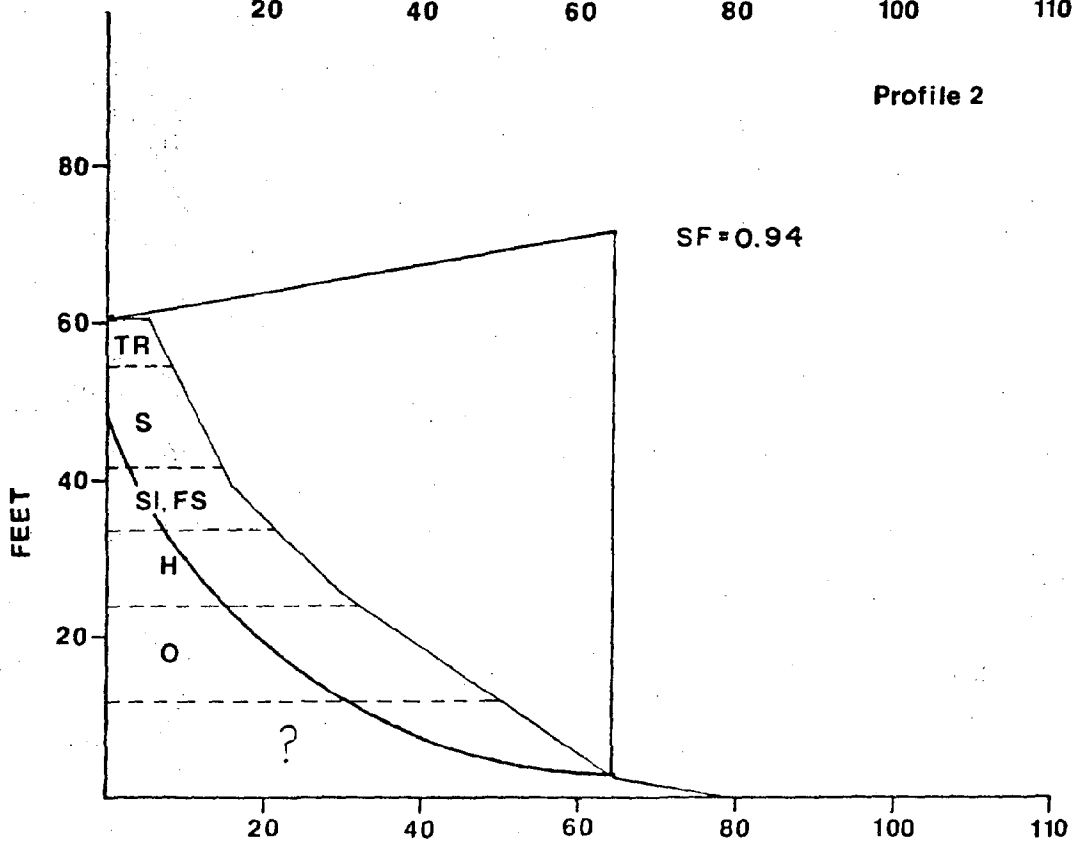


T 23 N, R 25 E, Sec. 31

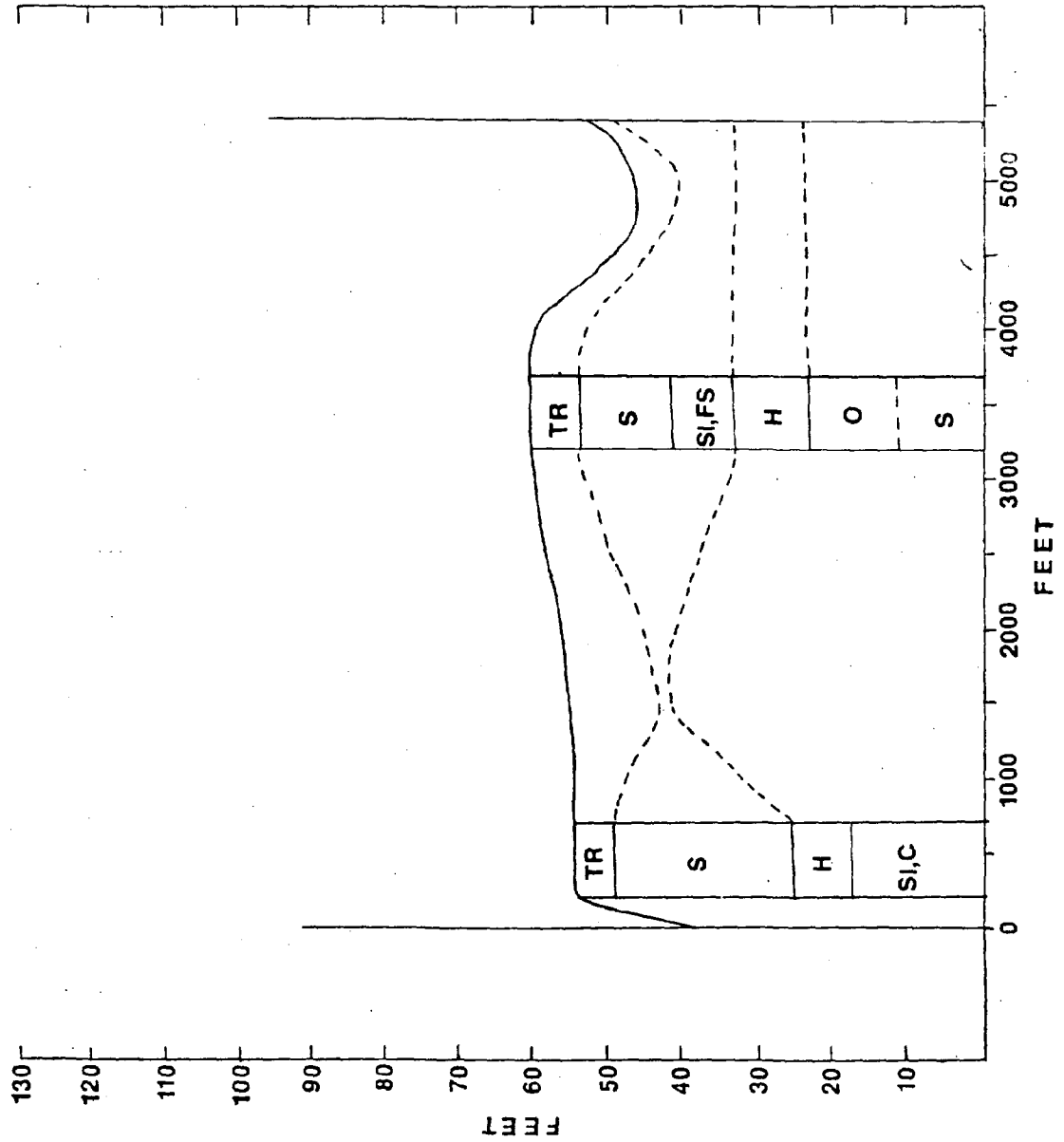
Profile 1



Profile 2



T23N, R25E, SEC. 31





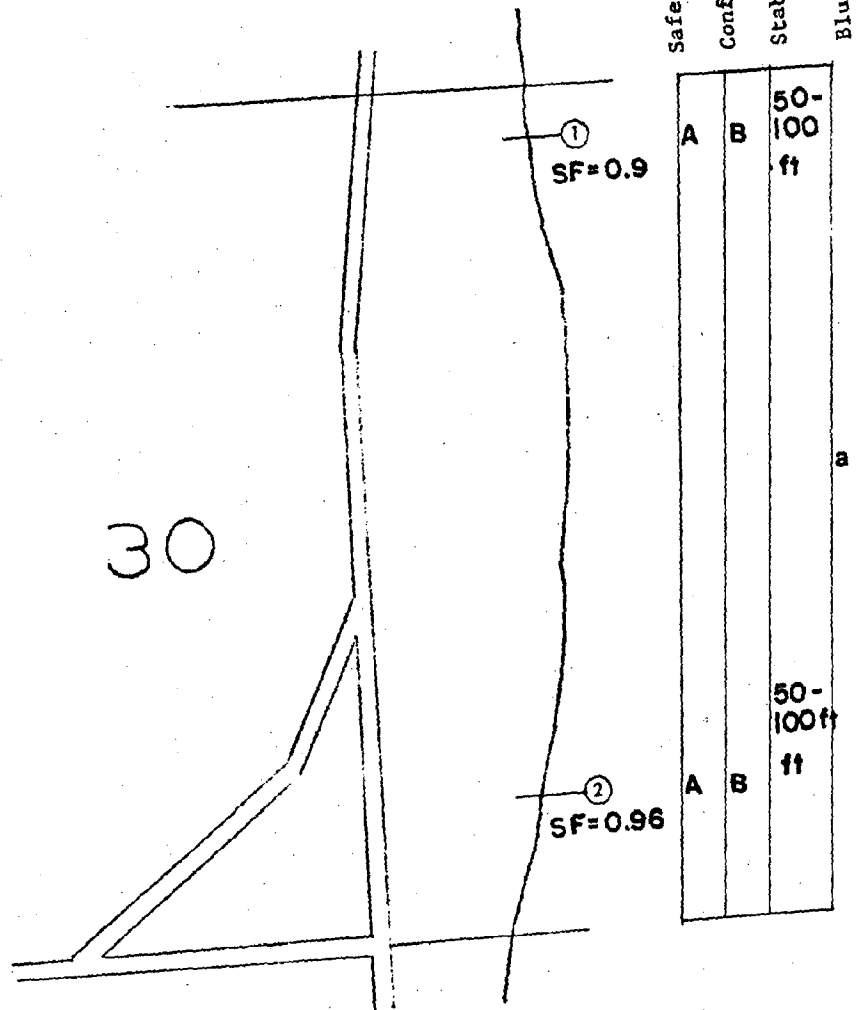
T.23N, R22E.  
 (Elevations)

SAFETY FACTOR

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 B-1.00 to 1.25  
 C-greater than 1.25

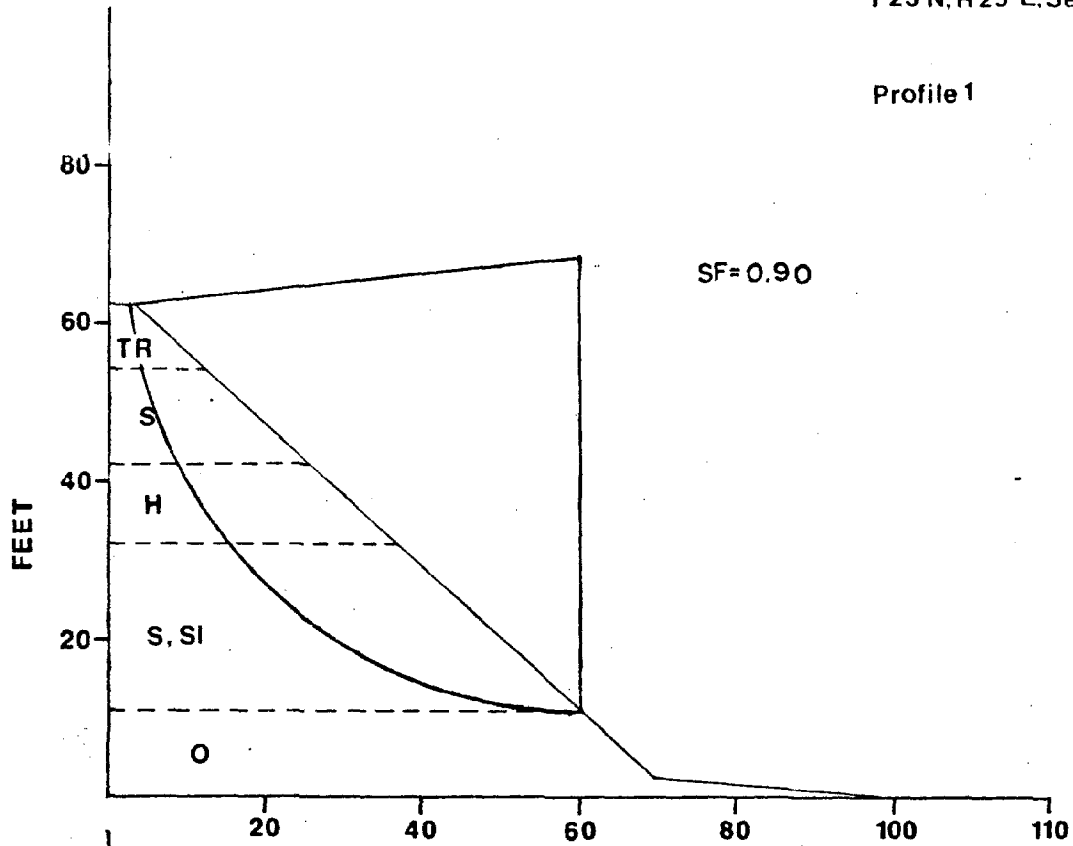
CONFIDENCE LEVEL

A-boreholes  
 (high confidence)  
 B-near boreholes  
 stratigraphy visible  
 C-no stratigraphy  
 visible (low  
 confidence)

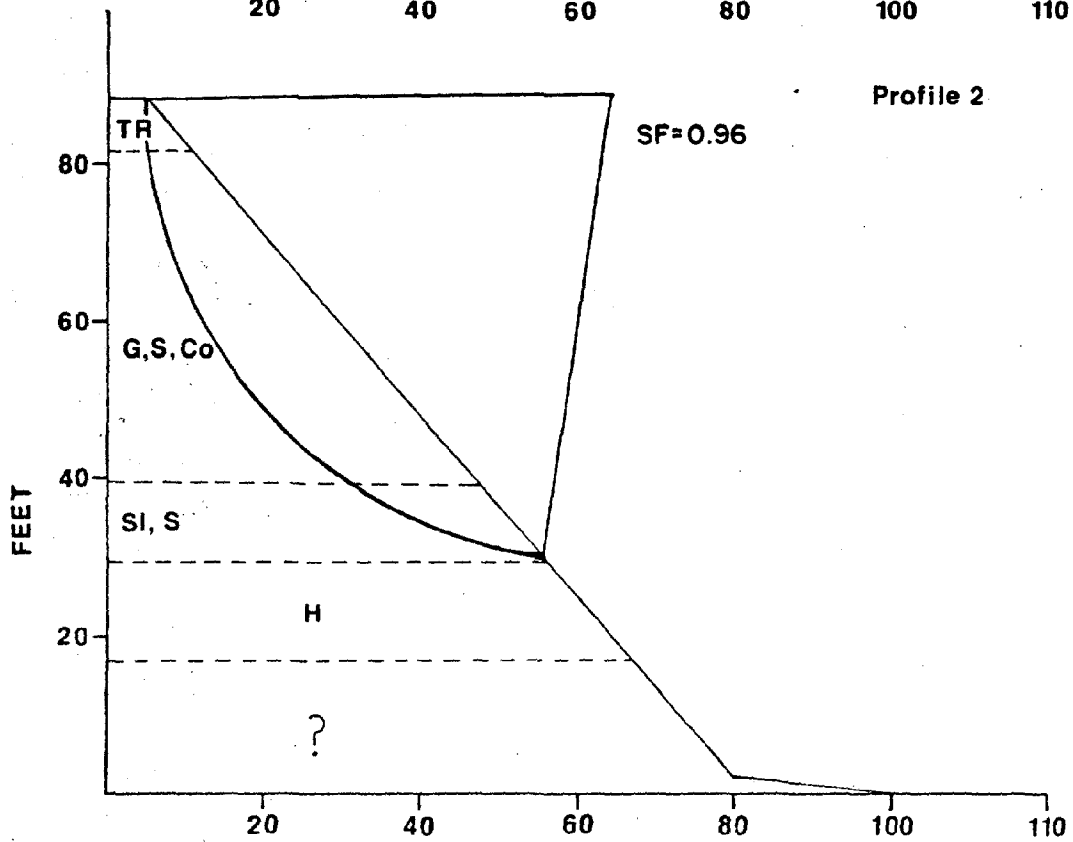


T23 N, R25 E, Sec. 30

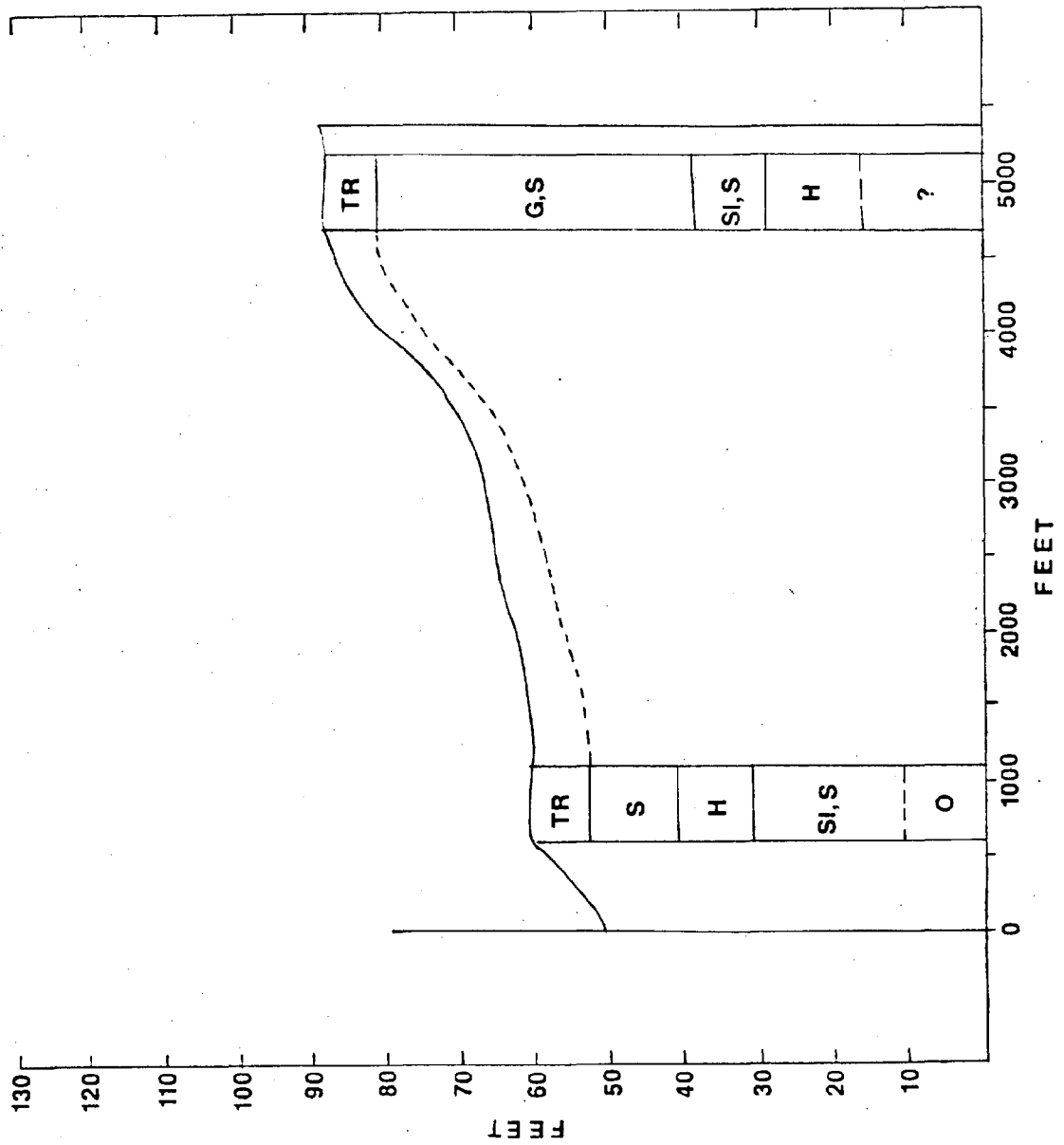
Profile 1

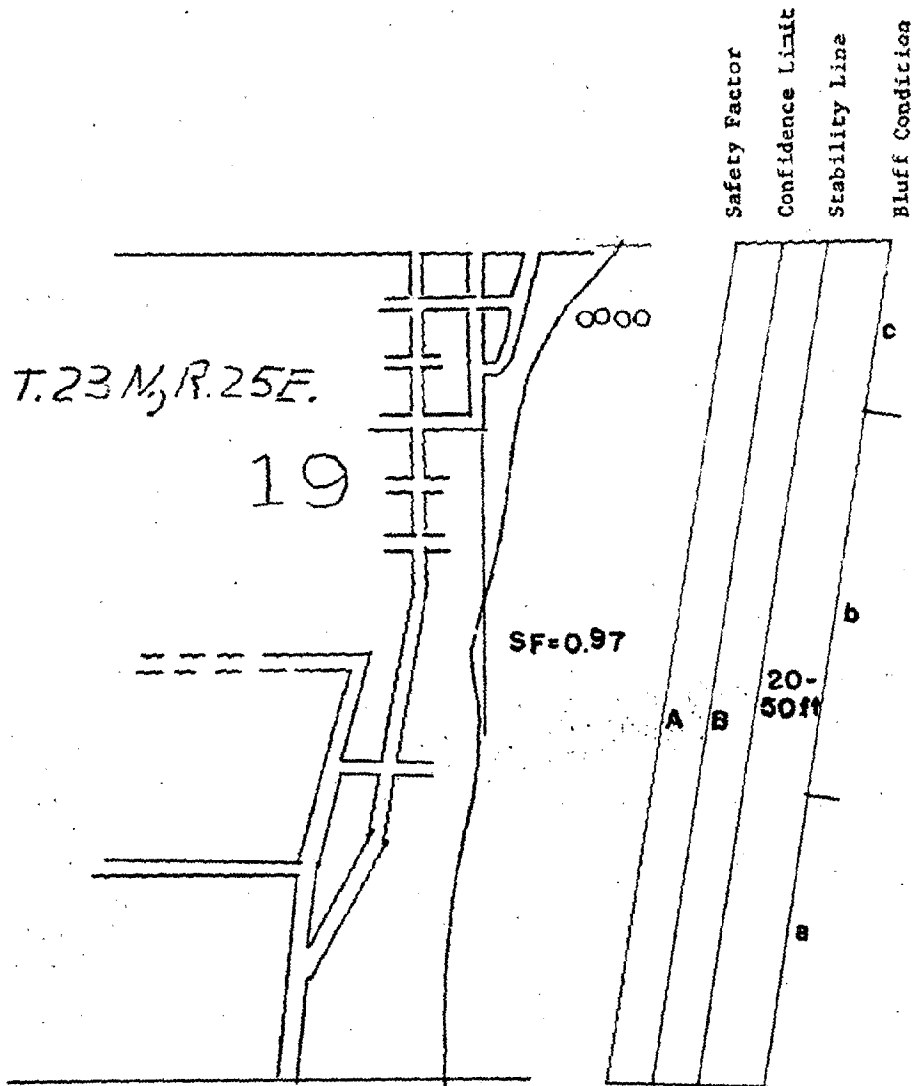


Profile 2



T23N R25E SEC.30



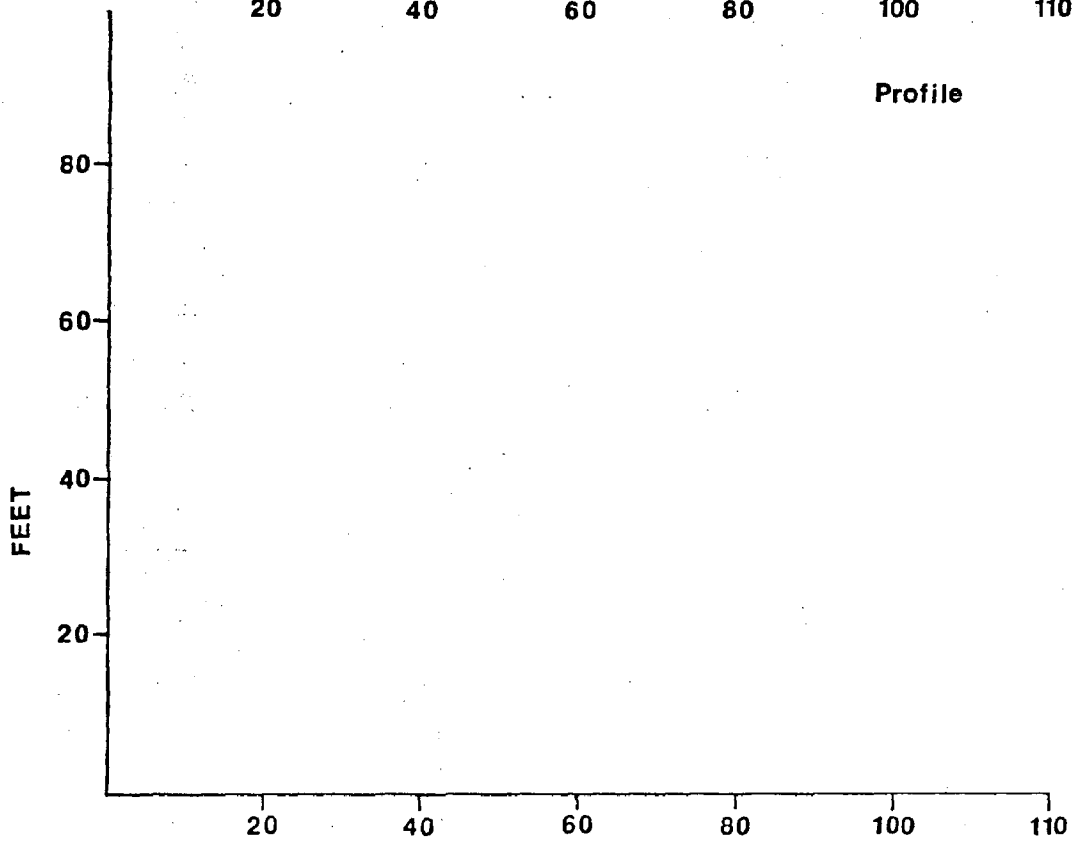
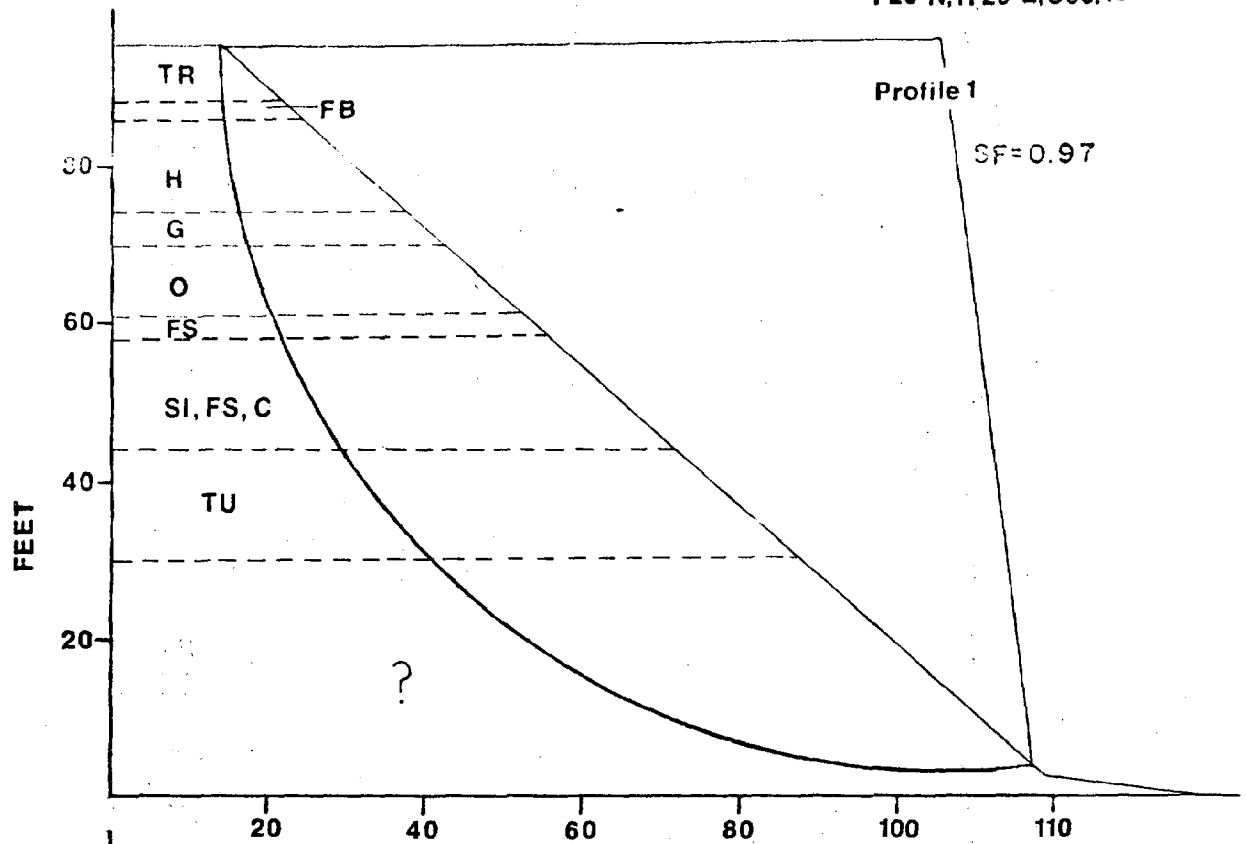
SAFETY FACTOR

- A-less than 1.00
- B-1.00 to 1.25
- C-greater than 1.25

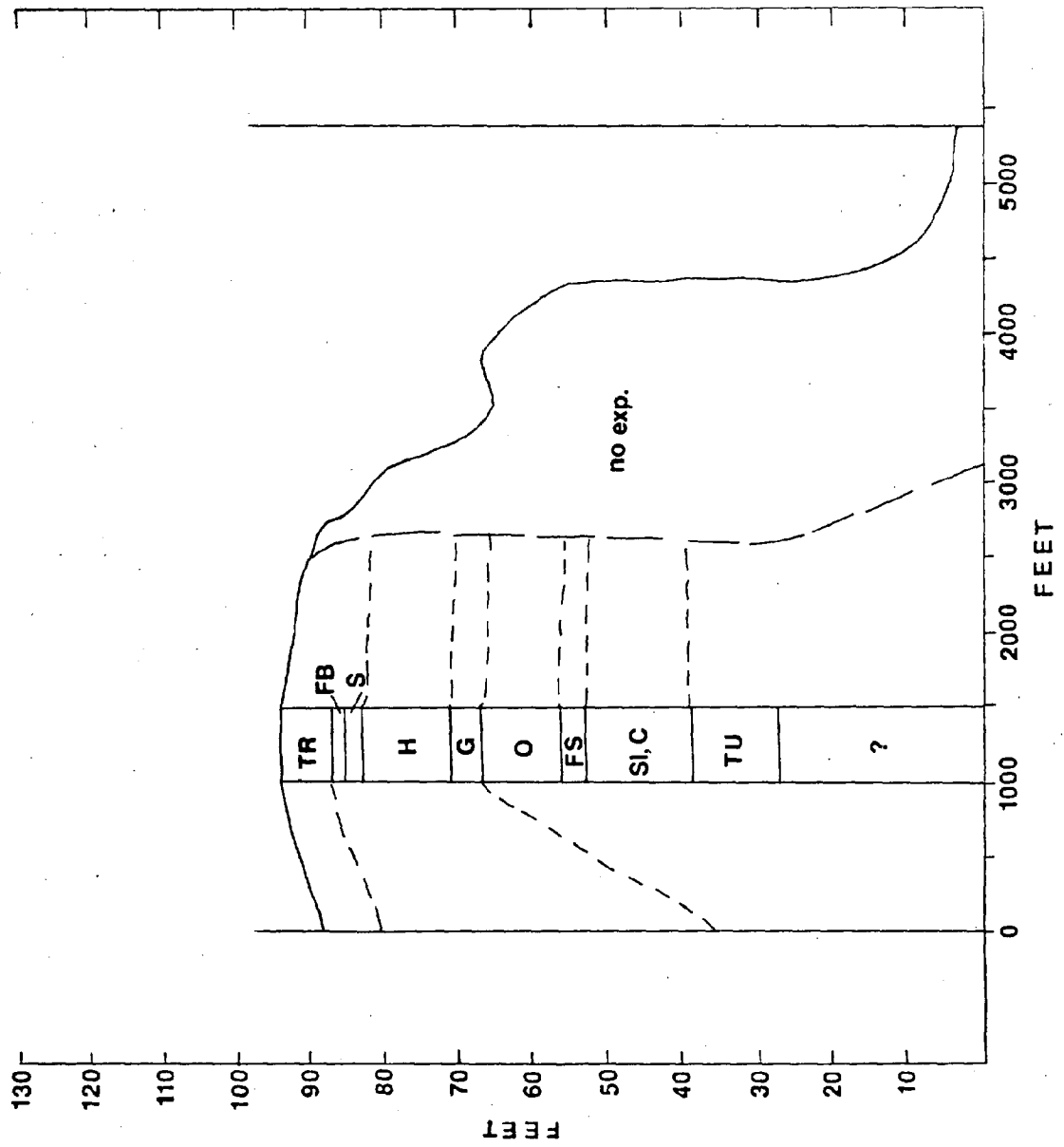
CONFIDENCE LEVEL

- A-boreholes  
(high confidence)
- B-near boreholes  
stratigraphy visible
- C-no stratigraphy  
visible (low  
confidence)

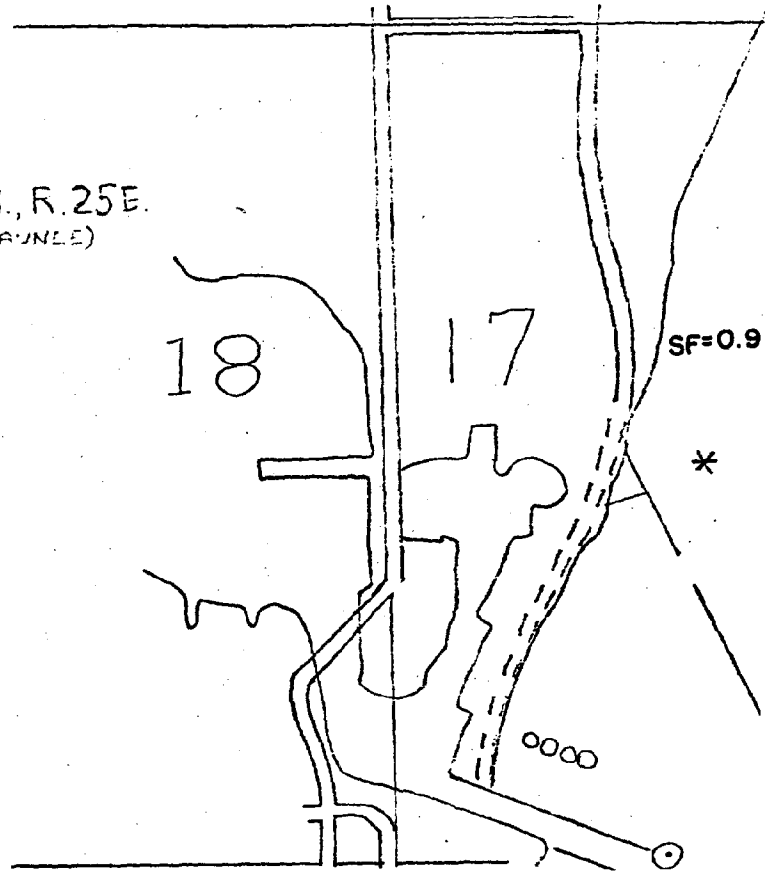
T23 N, R. 25 E, Sec. 19



## T23NR25E SEC.19



T.23N., R.25E.  
(KEWAUNEE)



Safety Factor  
Confidence Limit  
Stability Line  
Bluff Condition

|   |   |         |   |
|---|---|---------|---|
| A | B | 20-50ft | b |
|   |   |         |   |
|   |   |         | a |

SAFETY FACTOR

A-less than 1.00

B-1.00 to 1.25

C-greater than 1.25

CONFIDENCE LEVEL

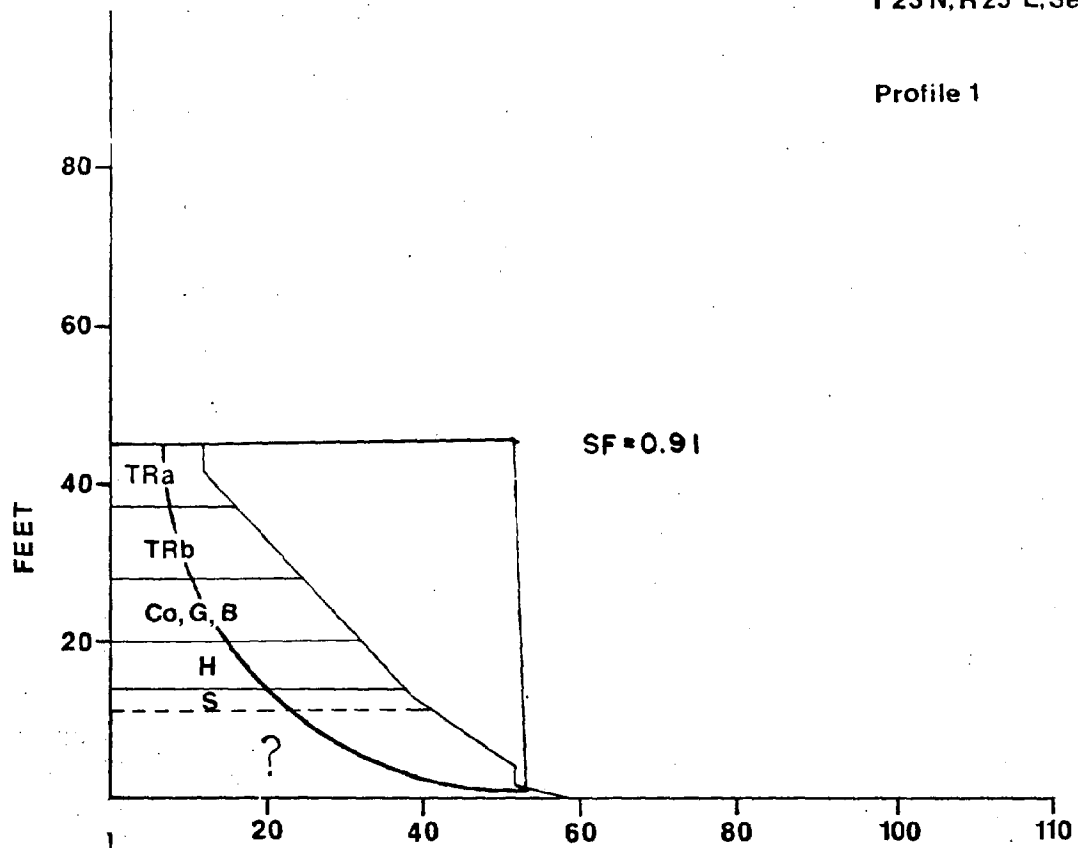
A-boreholes  
(high confidence)

B-near boreholes  
stratigraphy visible

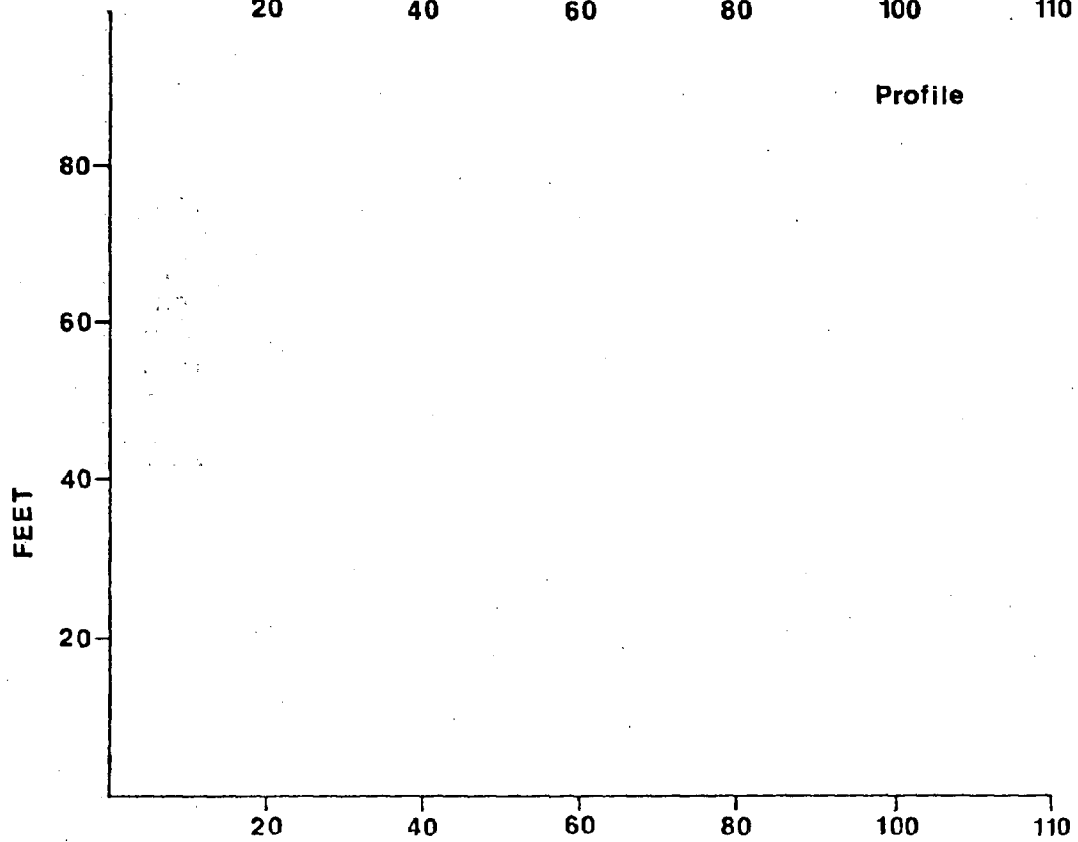
C-no stratigraphy  
visible (low  
confidence)

T 23 N, R 25 E, Sec. 17

Profile 1

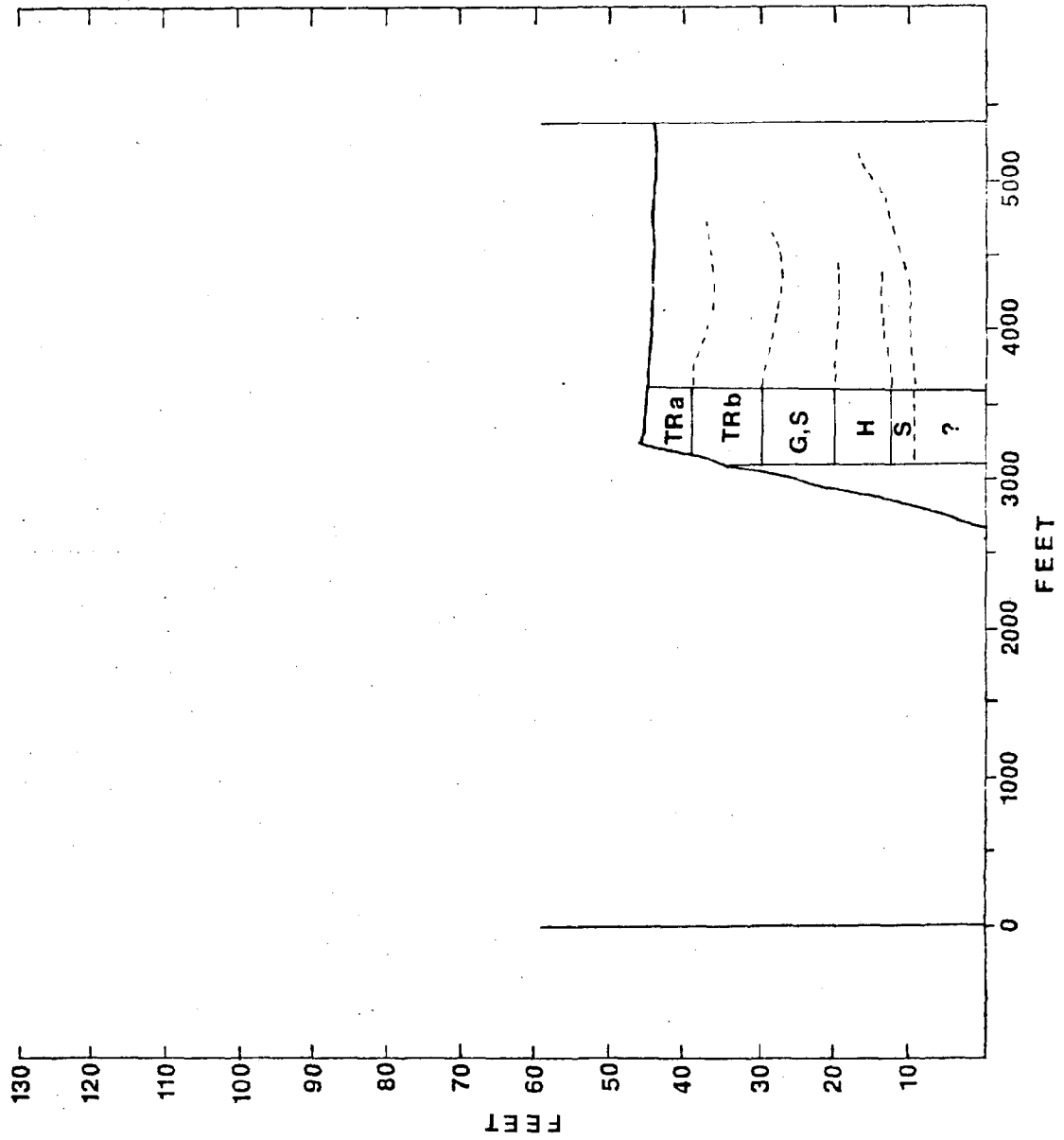


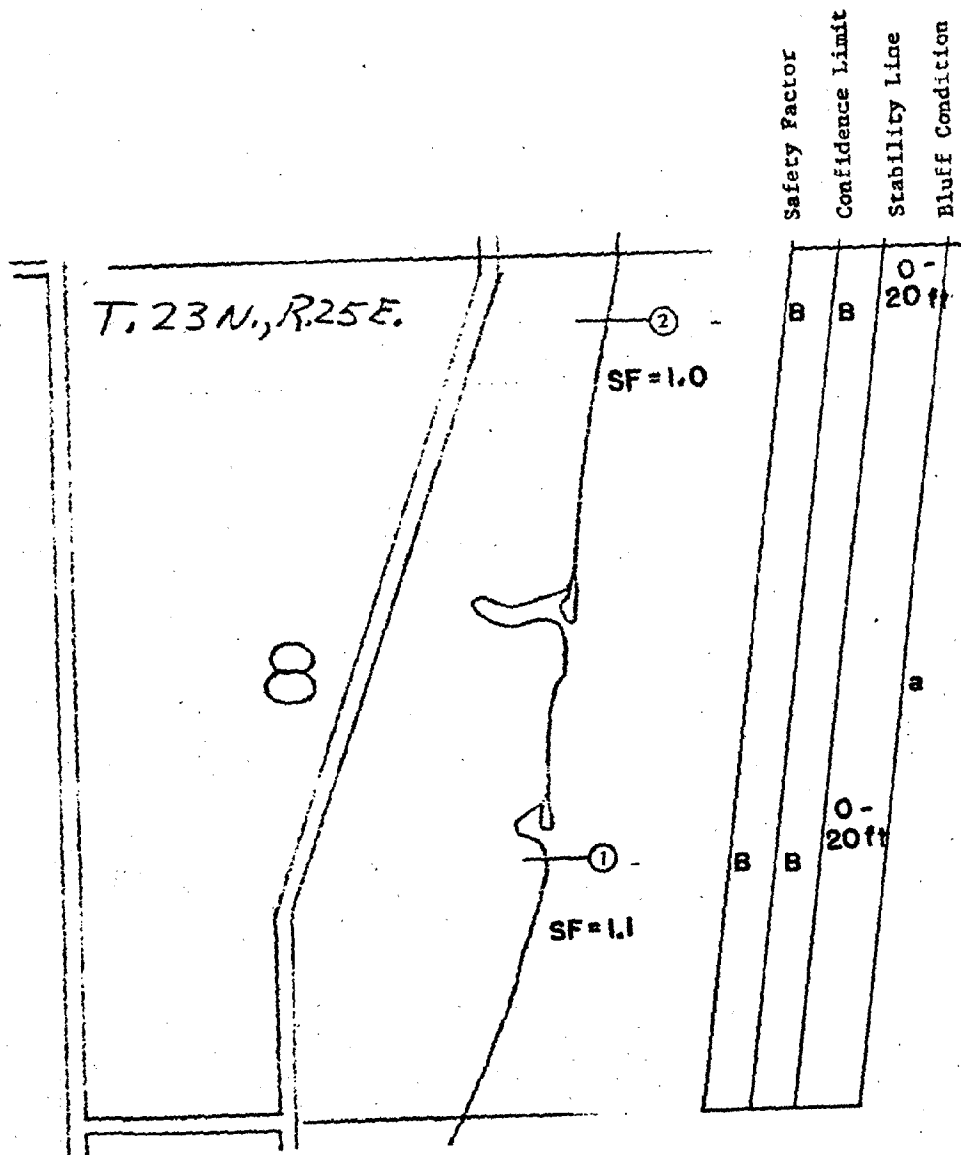
Profile





T23N R25E SEC.17



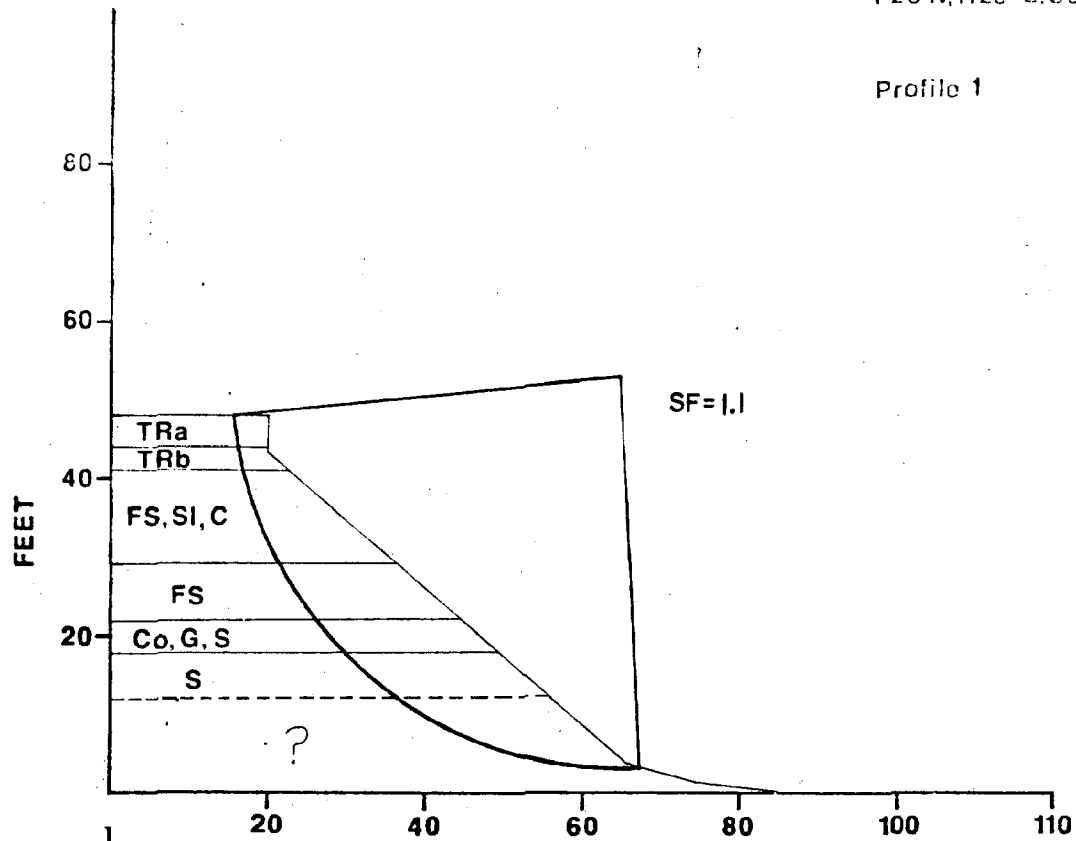


SAFETY FACTOR  
 A-less than 1.00  
 B-1.00 to 1.25  
 C-greater than 1.25

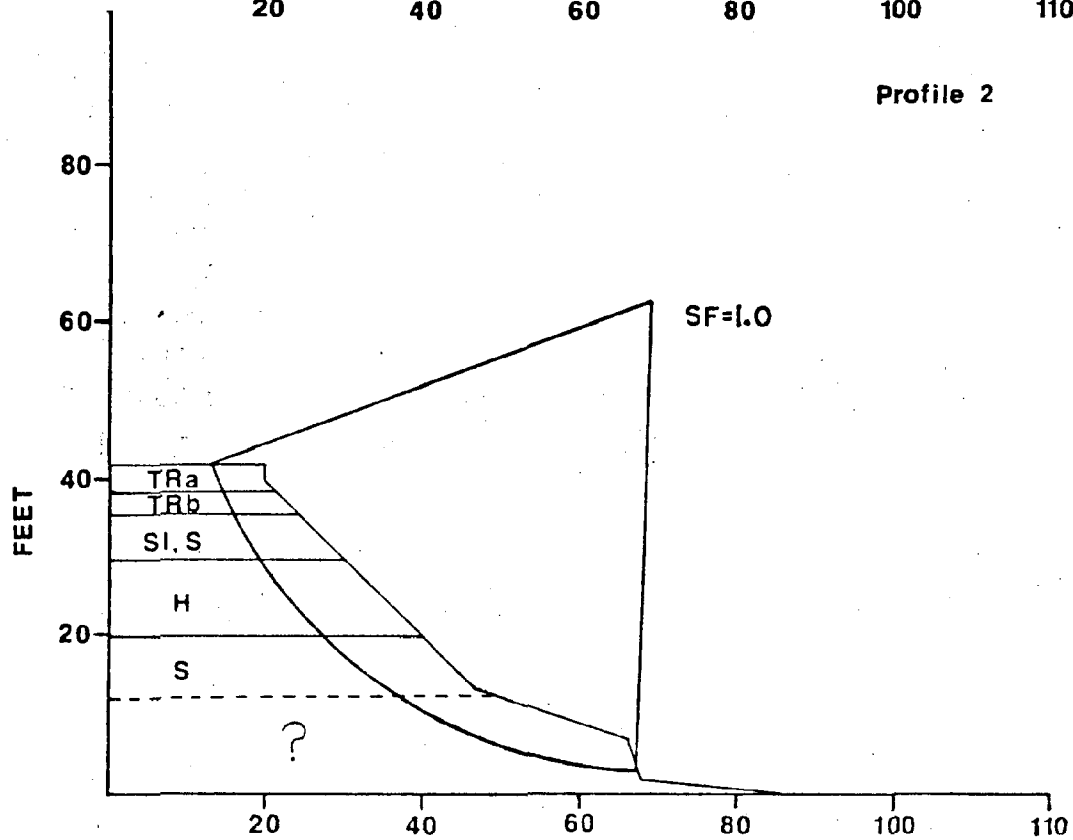
CONFIDENCE LEVEL  
 A-boreholes  
 (high confidence)  
 B-near boreholes  
 stratigraphy visible  
 C-no stratigraphy  
 visible (low  
 confidence)

T23 N, R25 E, Sec. 8

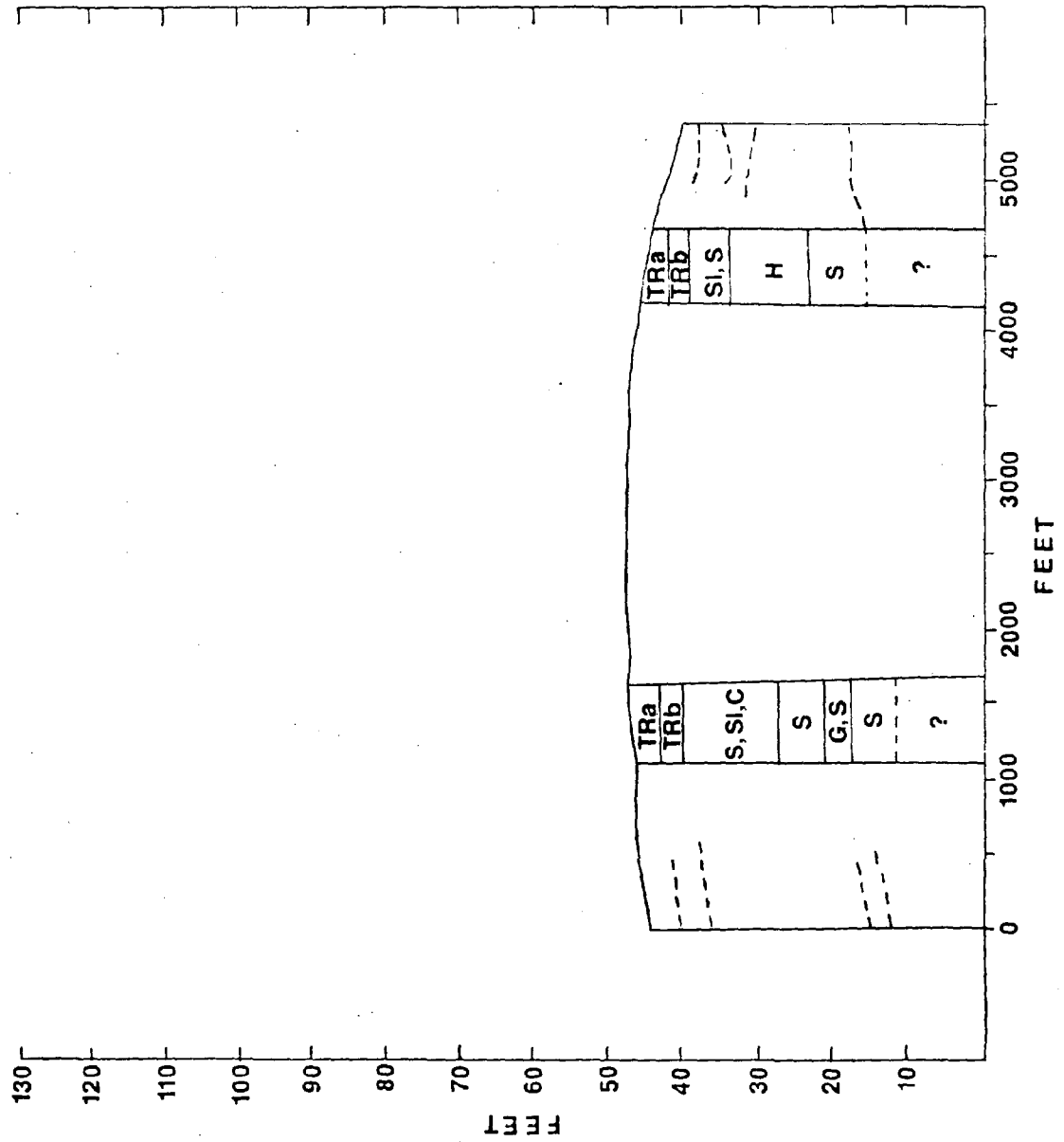
Profile 1

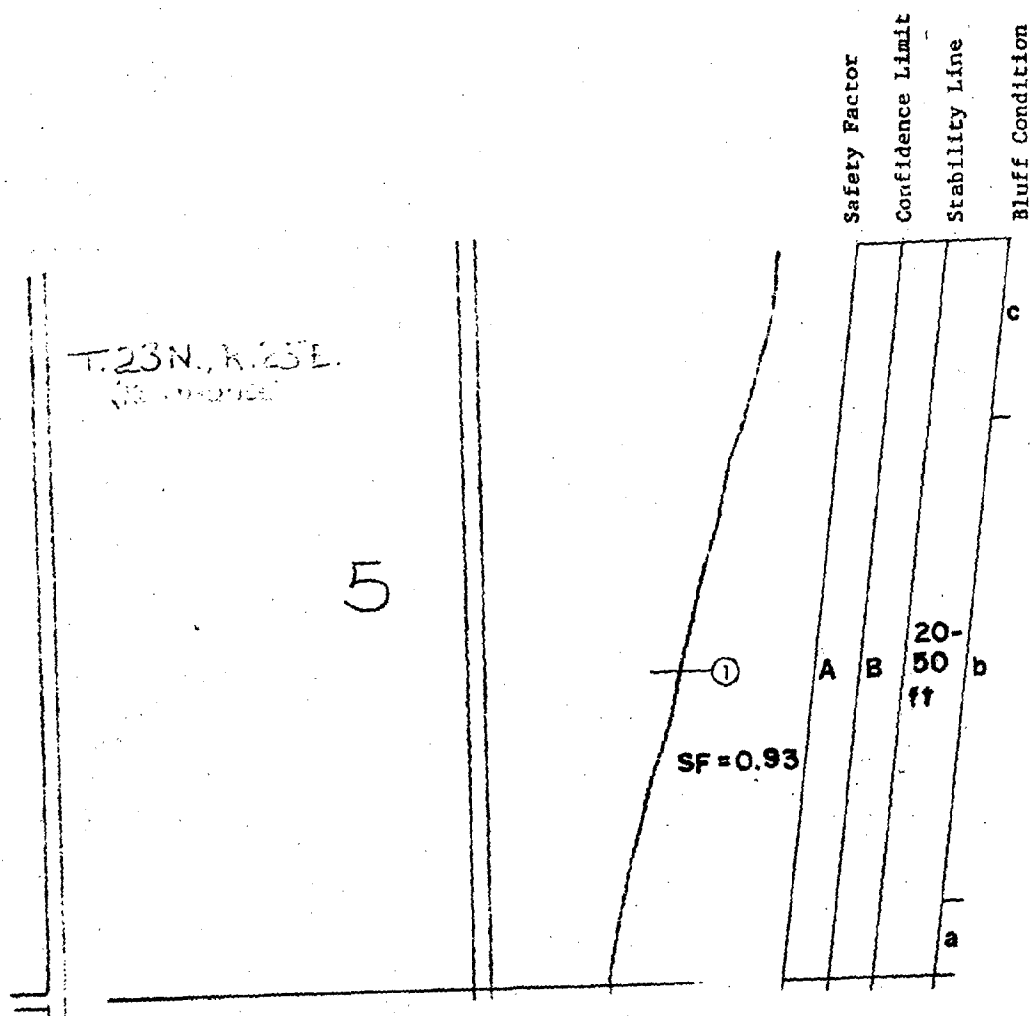


Profile 2



## T23NR25E SEC. 8



SAFETY FACTOR

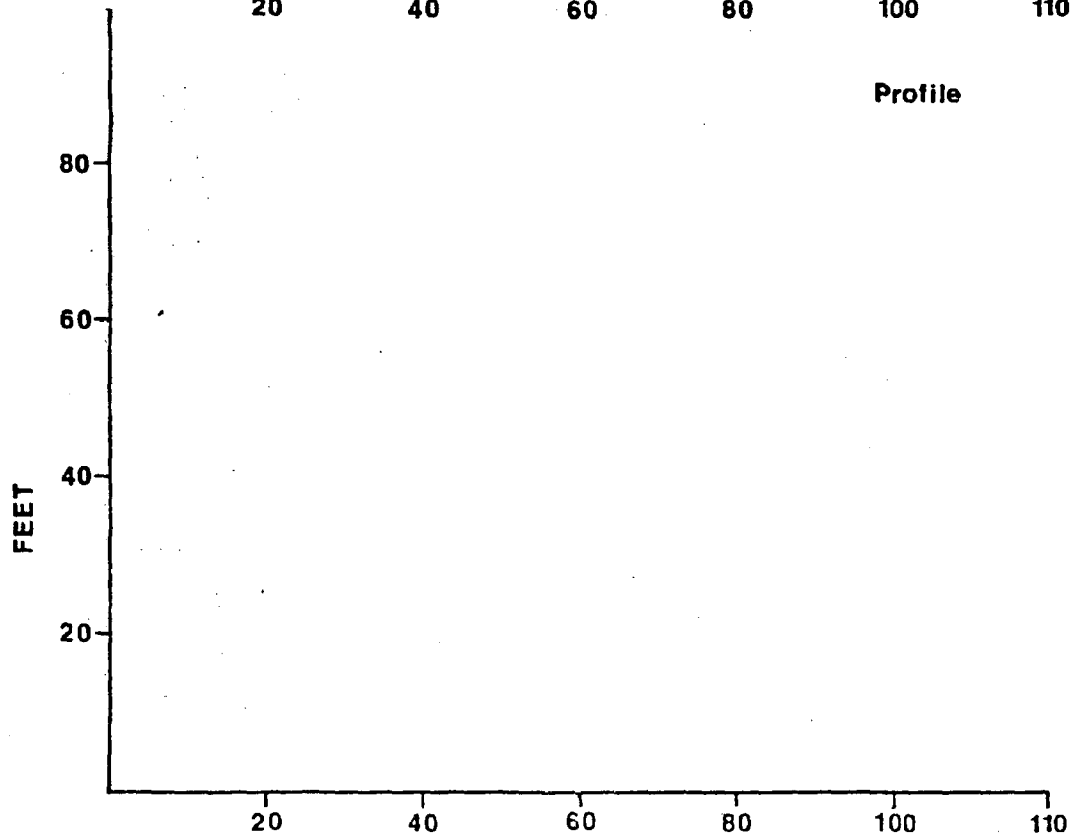
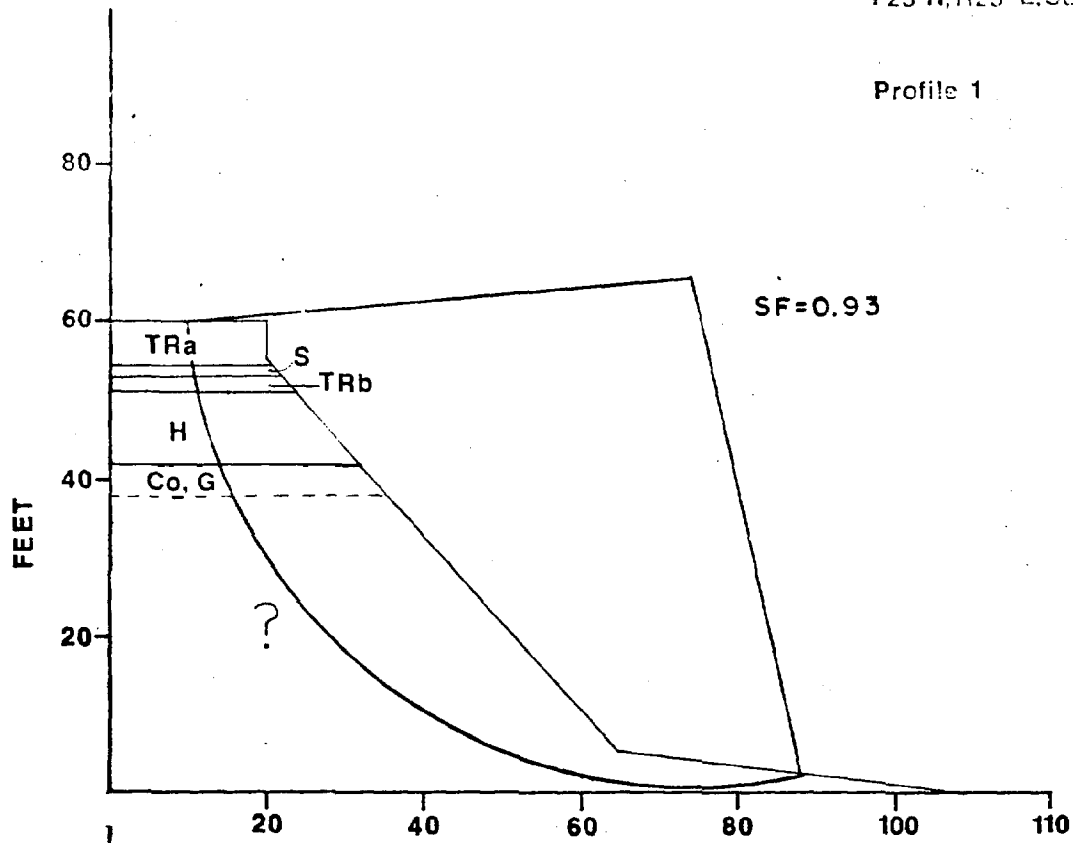
- A-less than 1.00
- B-1.00 to 1.25
- C-greater than 1.25

CONFIDENCE LEVEL

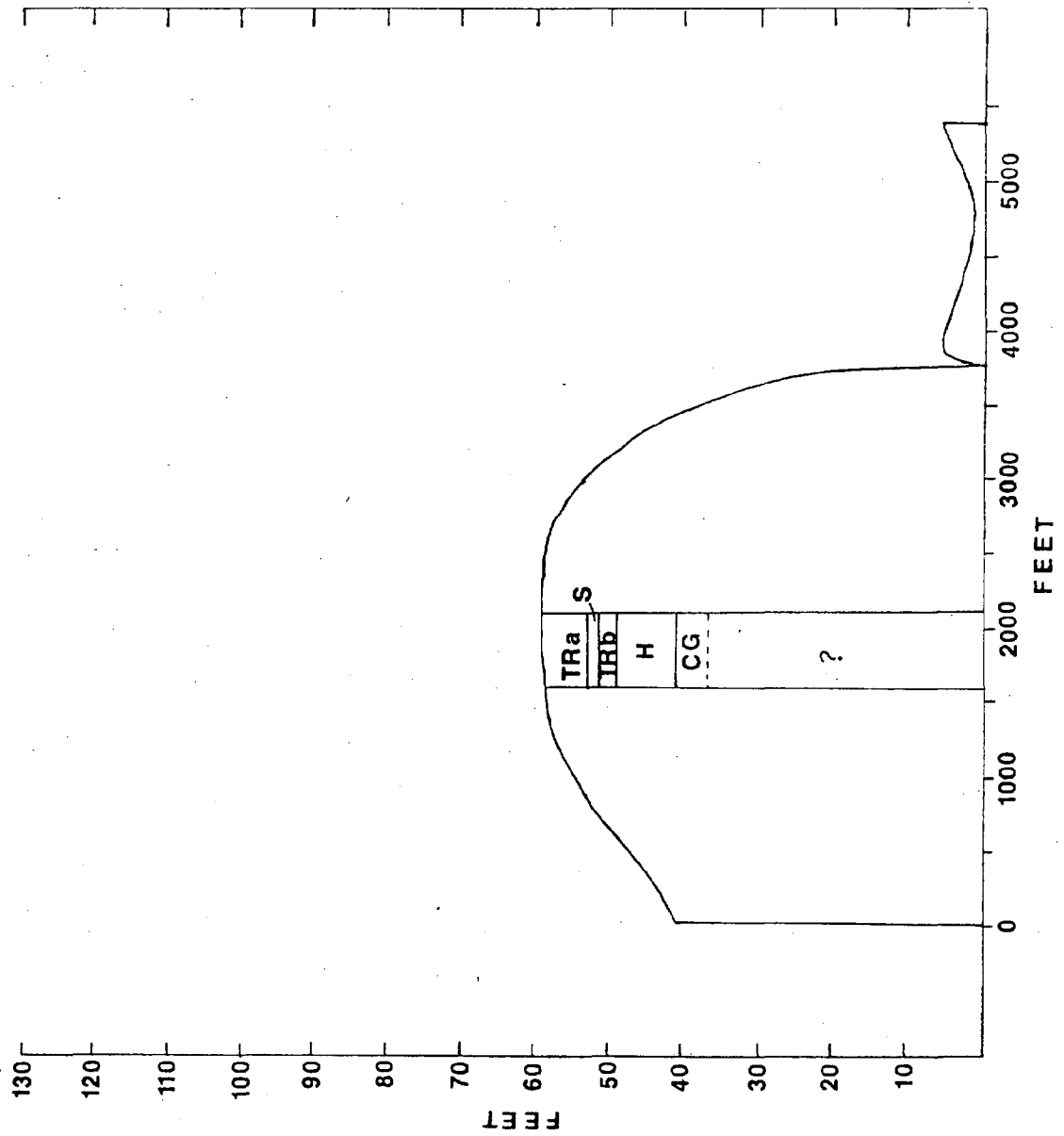
- A-boreholes  
(high confidence)
- B-near boreholes  
stratigraphy visible
- C-no stratigraphy  
visible (low  
confidence)

T23 N, R25 E, Sec. 5

Profile 1



T23N.B25E SEC. 5



T. 24 N., R. 25 E.

## T. 24 N., Sec. 32/29

Section 32/29 is divided into three subsections. In the southern one-third (a) the bluff ranges from 0 to 5 feet in height and is largely unvegetated. No large failures are evident. The bluff is protected by rip-rap 200 feet on either side of the pumping station at 32/29.2. The beach is generally 5 to 15 feet wide and consists of sand with occasional cobbles and boulders.

In the middle one-third of the section (b) the bluff is 35 to 45 feet high with little to no vegetation. Bluff failure is by shallow slides, small slumps and headward erosion of gullies. The stratigraphy of the upper half of the bluffs consists of 5 to 10 feet of red clayey till over 3 to 8 feet of red brown till (all Two Rivers) over 5 to 10 feet of brown clayey Haven till. The lower half of the bluff is covered with debris which obscures the stratigraphy. The beach is the same as that described in the previous subsection.

The northern third of the section (c) consists of bluffs 40 to 50 feet high with 30 percent vegetation (trees). Bluff failure is by small slumps and slides as well as by headward eroding gullies. The lower one-half to one third of the slopes are covered by debris. Bluff stratigraphy, beach width and composition are the same as in the previous subsection.

## T. 24 N., Sec. 28/29

Section 28/29 is divided into two subsections. From the south end of the section to 28/29.3 (a) the bluffs are 50 to 60 feet high with a rolling crest. The slopes are 95 percent vegetated with herbs, shrubs and trees and slope failure is relatively uncommon. Stratigraphy consists of three till units each 5 to 10 feet thick. The clayey Two Rivers till caps the bluff and overlies brown Haven till. The lower bluff stratigraphy is largely covered. The sand beach in this subsection is 20 to 30 feet wide.



From 28/29.3 to the end of the section (b) the bluff is 50 to 60 feet high and has a uniform crest. The southern two-thirds of the subsection is 0 to 10 percent vegetated while the northern third is 40 to 60 percent vegetated. Slope failure is by small slides and small to large slumps. Four headward eroding gullies are also observed in this subsection. Bluff is similar to that in the southern subsection except that discontinuous layers and lenses of sand and sand and gravel are observed on top of, between and within the three till units. The beach is 5 to 25 feet wide and composed primarily of cobbles, pebbles and boulders with sand becoming prevalent in the northern one-fourth of the subsection.

#### T. 24, Sec. 21

Section 21 (a) contains bluffs 65-70 feet high throughout. The slopes are 30 to 40 percent vegetated with herbs, shrubs, and trees. Bluff failure is by small to large slumps and small slides. Several headward eroding gullies are also present in the section. The bluff stratigraphy is very discontinuous and confused, but generally consists of a cap of Two Rivers till over about a 5 foot layer of red-brown till (all Two Rivers) less than 40 feet of brown Haven till. The till units, in places, are separated by, and/or contain, lenses and pods of gravel, sand, silt, or clay up to 40 feet thick. The stratigraphy near the toe of the bluffs is obscured by debris. The beach is 0 to 15 feet wide and consists of cobbles and boulders in the southern one-third and sand in the northern two-thirds of the section.

#### T. 24 N., Sec. 16

Section 16 contains bluffs which decrease from 60 feet high at the south end of the section to 25 feet at the north (a). The bluffs are 10 percent vegetated except at the extreme south of the section where they are about 35%

vegetated. Slope erosion is by small slides, small to large slumps, and headward eroding gullies. The bluffs are capped by 6 feet of orange-red sandy till over red-brown clayey till (all Two Rivers). This overlies 10 to 40 feet of various discontinuous sand, gravel, silt and till units.

The beach is 0 to 20 feet wide and consists of sand with pebbles, cobbles and a few boulders.

Near 16.7 are two segments of rip-rap, approximately 150 feet long. These segments are protecting the toe from direct erosion and appear to have partially stabilized the slopes directly behind them.

#### T. 24 N., Sec. 9/10

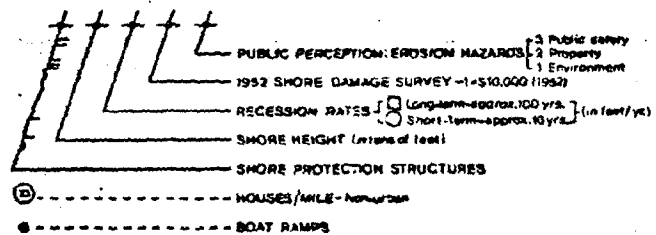
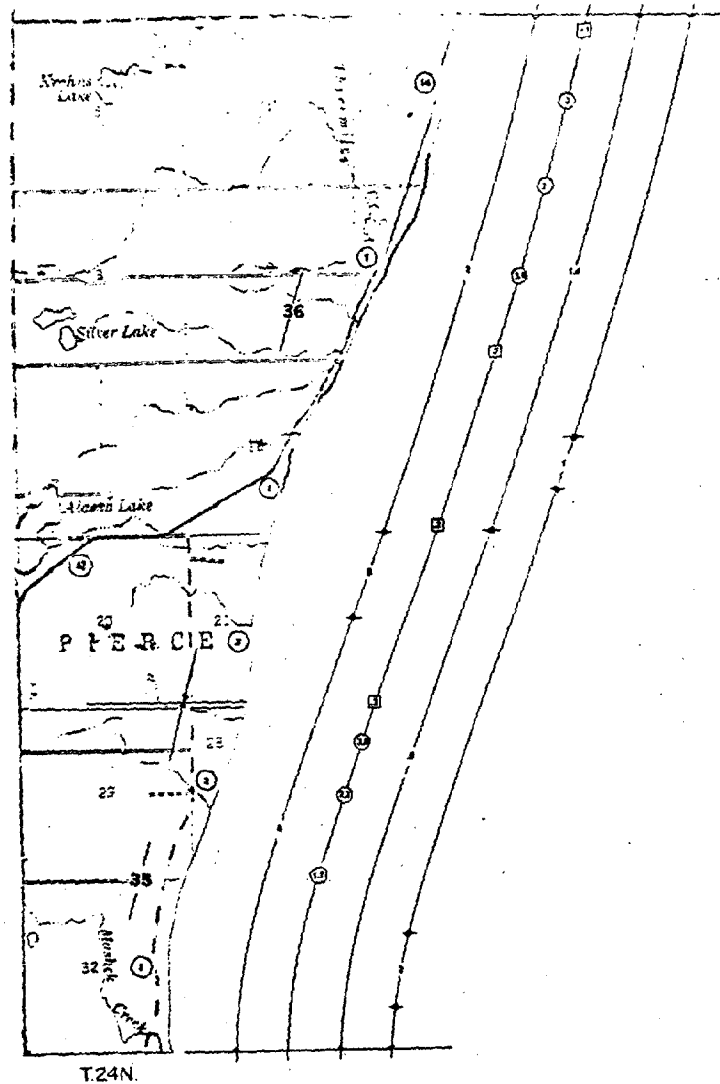
The bluff in section 9/10 is divided into three segments. From the southern end of the section to 9/10.2 (a) the bluff decreases in height from 20 feet to a terrace with no bluff at all. The slope is unvegetated and is failing by medium to small slumps and slides. From 9/10.2 to 9/10.5 (b) the bluff rises from the terrace to a height of 20 feet. This segment is 100 percent vegetated with herbs and shrubs. A few medium sized slumps are present. From 9/10.5 to the north end of the section (c) the bluff again diminishes in height. The bluffs in this segment are 10 percent vegetated with herbs, shrubs, and trees. Medium to small slumps and small slides are the dominant mode of slope failure.

The stratigraphy in this section consists of approximately 2 feet of sand overlying 2 feet of red, stoney till. This overlies about 2 feet of loose, sandy till which overlies Haven or Ozaukee till. The beach is 10 to 25 feet wide and is composed of 50 percent sand and 50 percent pebbles and cobbles.

#### T. 24 N., Sec. 3

There is no bluff in this section. The shoreline is characterized by

sand beaches 20 to 70 feet wide built upon a low, flat terrace surface. In some areas the beach is separated from the terrace surface by a 5 to 10 foot high sand bank. The terrace has been largely cleared of vegetation and made into home sites, however, small clumps of trees persist near the southern end of section 3.



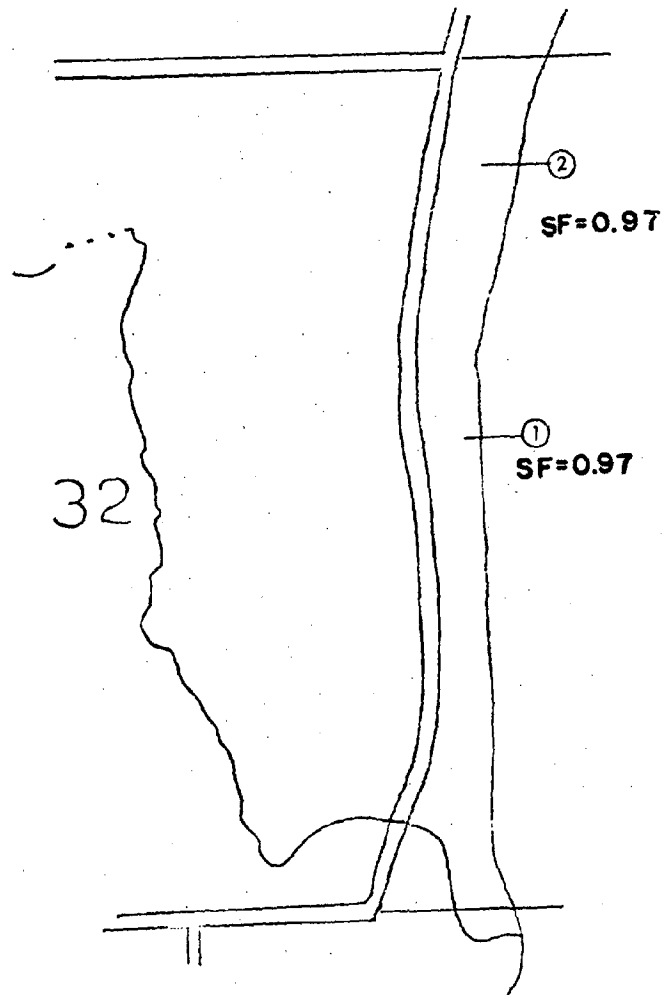
T.24N., R. 25E.  
(ALGONA)

SAFETY FACTOR

- A-less than 1.00
- B-1.00 to 1.25
- C-greater than 1.25

CONFIDENCE LEVEL

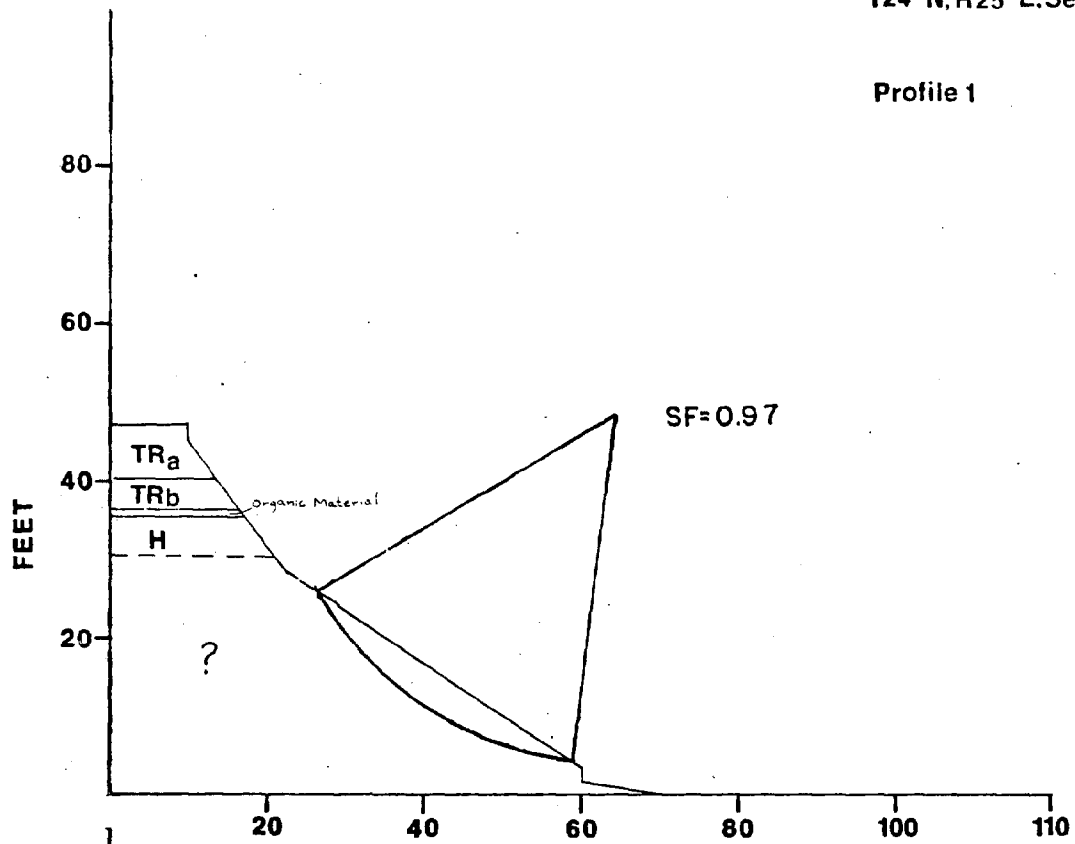
- A-boreholes  
(high confidence)
- B-near boreholes  
stratigraphy visible
- C-no stratigraphy  
visible (low  
confidence)



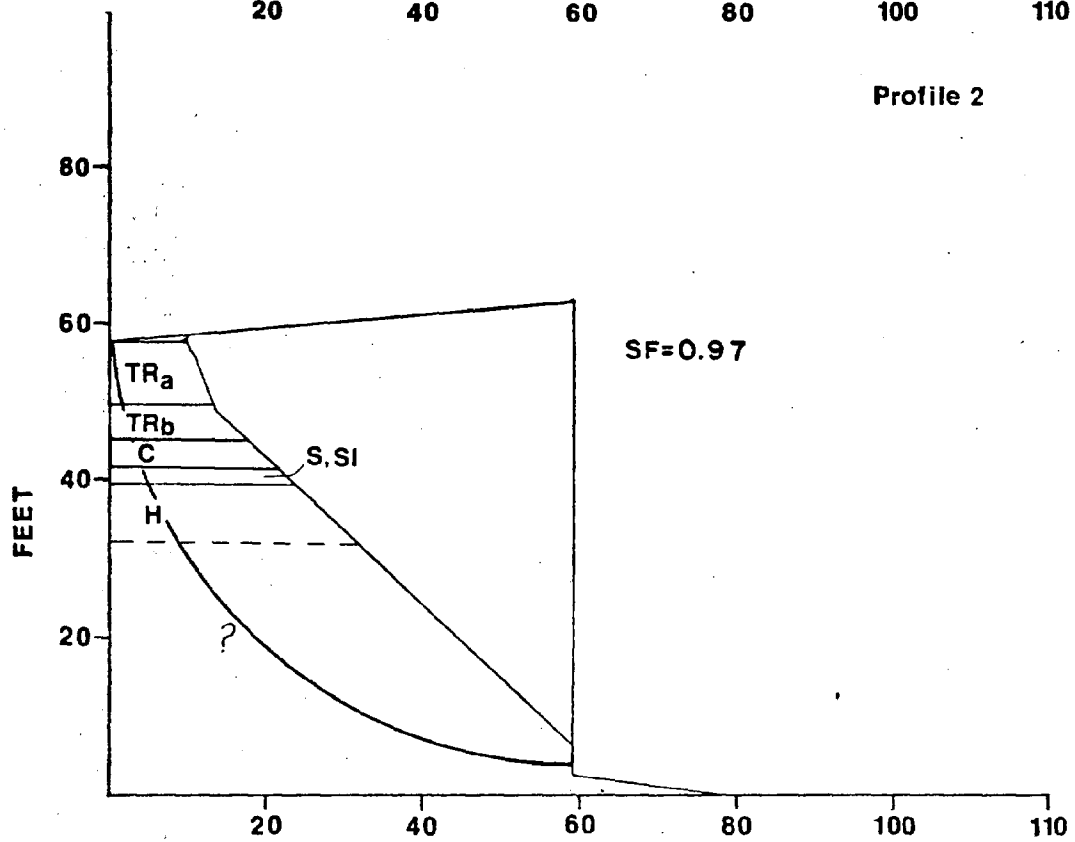
| Safety Factor | Confidence Limit | Stability Line | Bluff Condition |
|---------------|------------------|----------------|-----------------|
| A             | B                | 20-50 ft       | c               |
| A             | B                | 20-50 ft       | b               |
|               |                  |                | a               |

T24 N, R25 E, Sec. 32

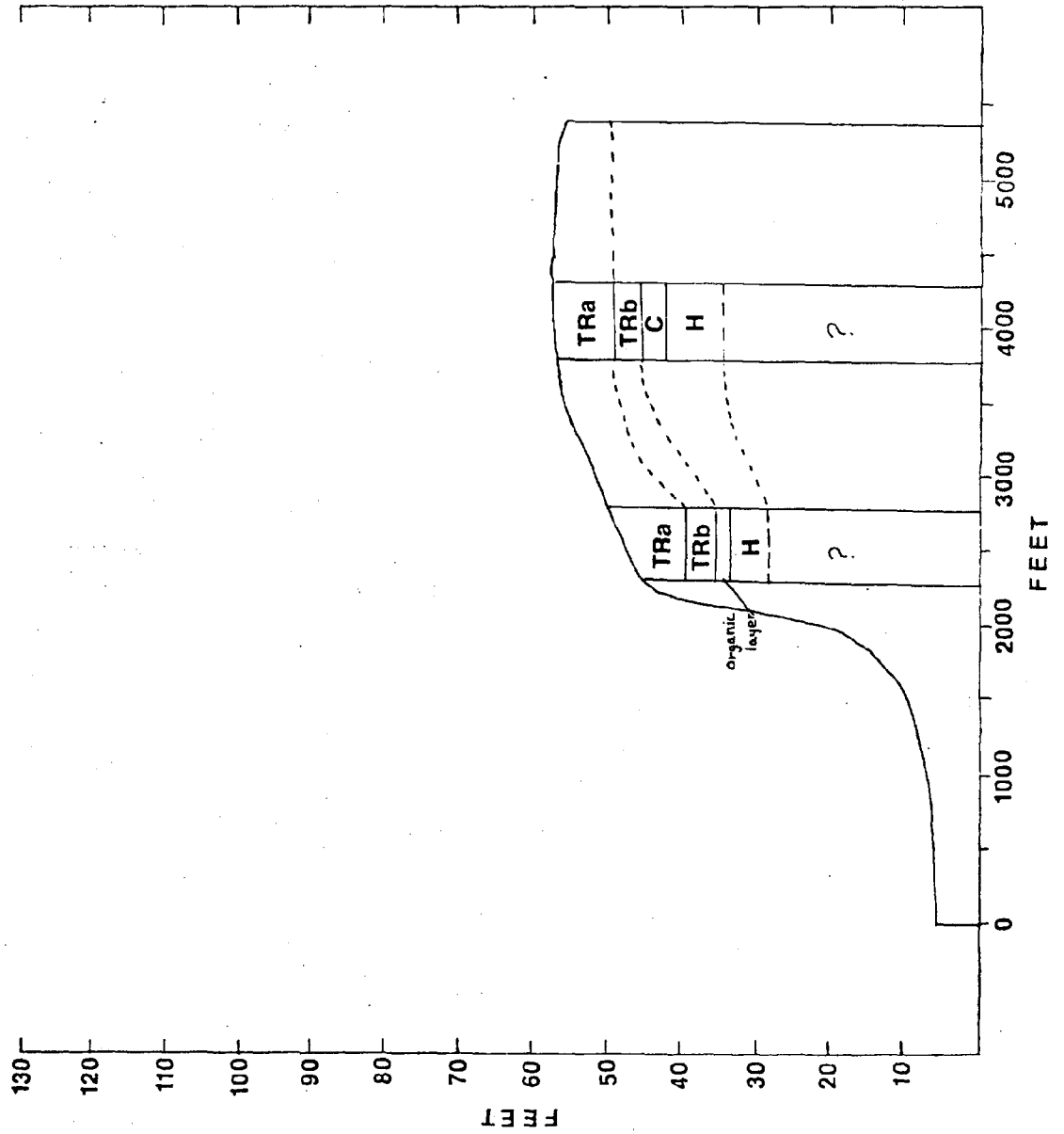
Profile 1

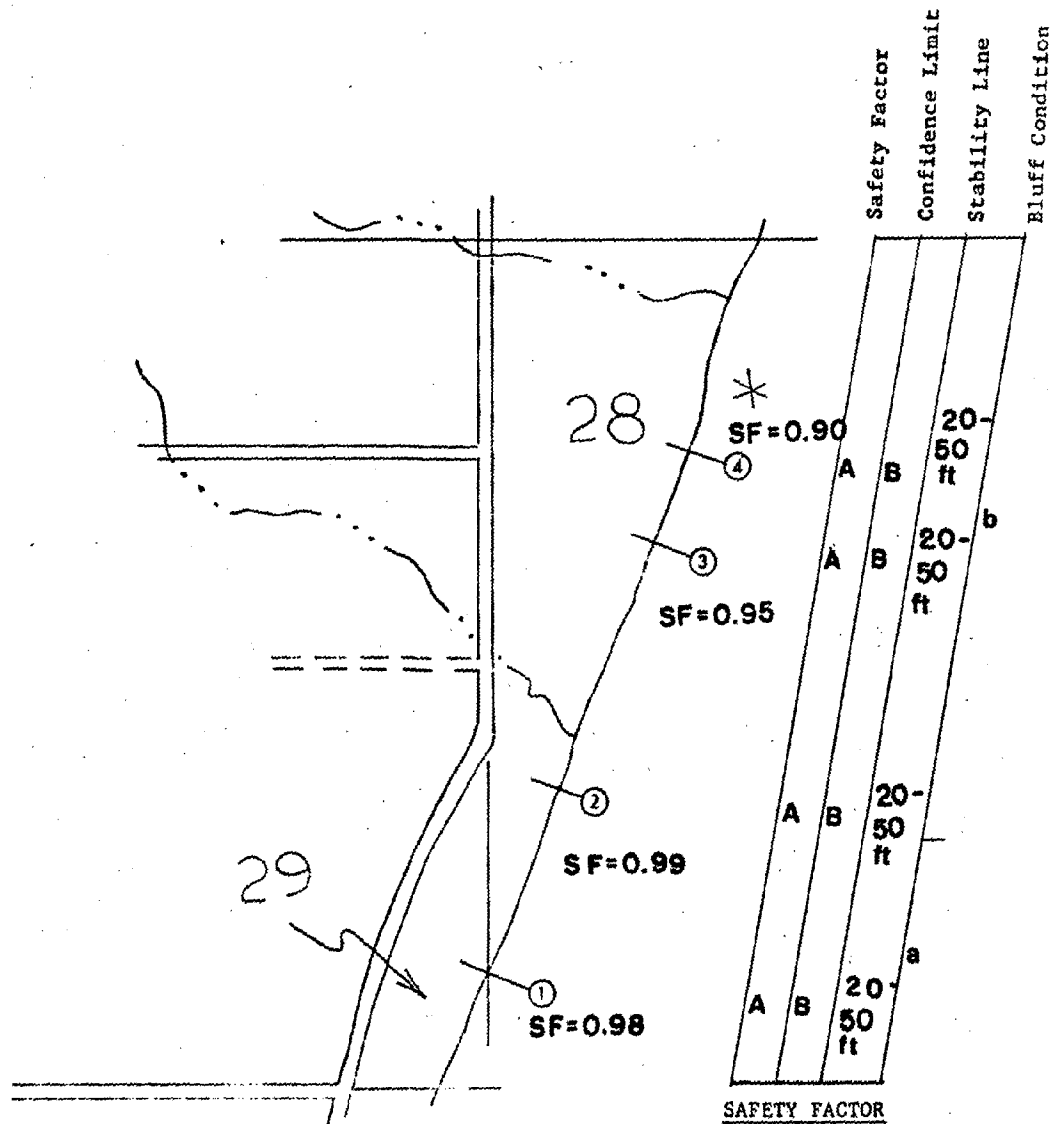


Profile 2



## T24N, R25E, SEC. 32



**SAFETY FACTOR**

- A-less than 1.00
- B-1.00 to 1.25
- C-greater than 1.25

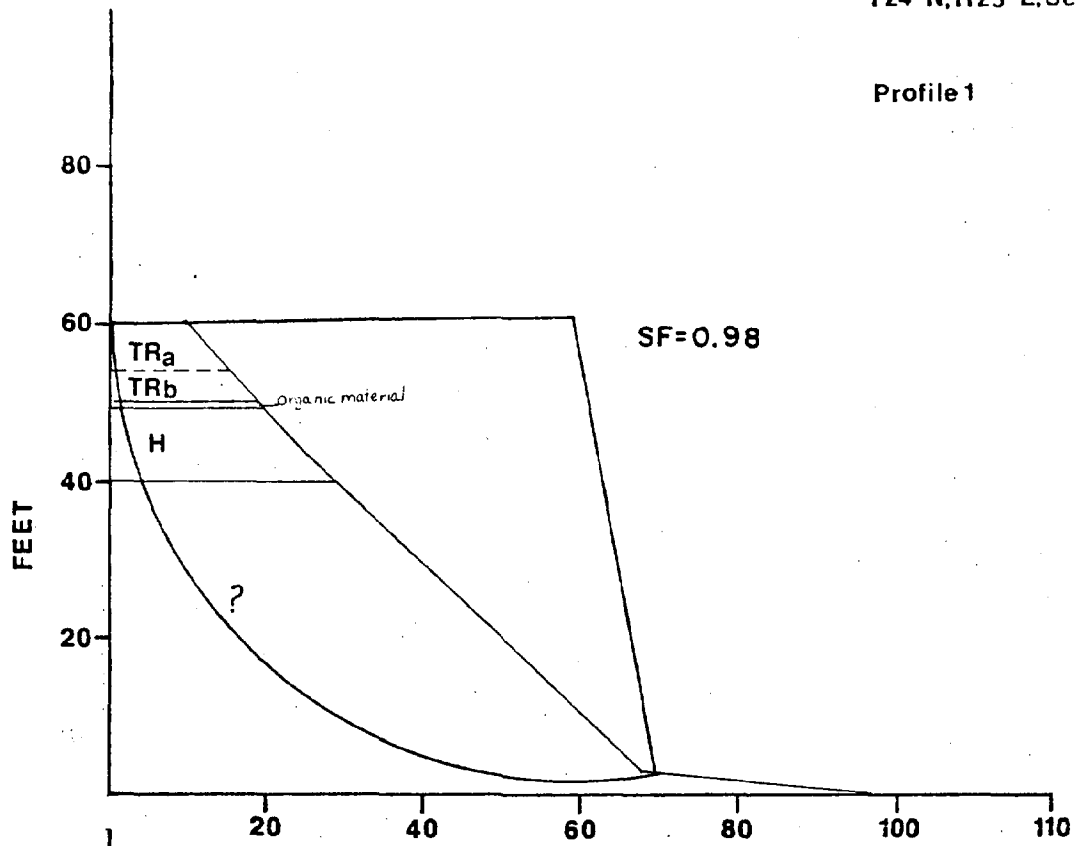
**CONFIDENCE LEVEL**

- A-boreholes (high confidence)
- B-near boreholes stratigraphy visible
- C-no stratigraphy visible (low confidence)

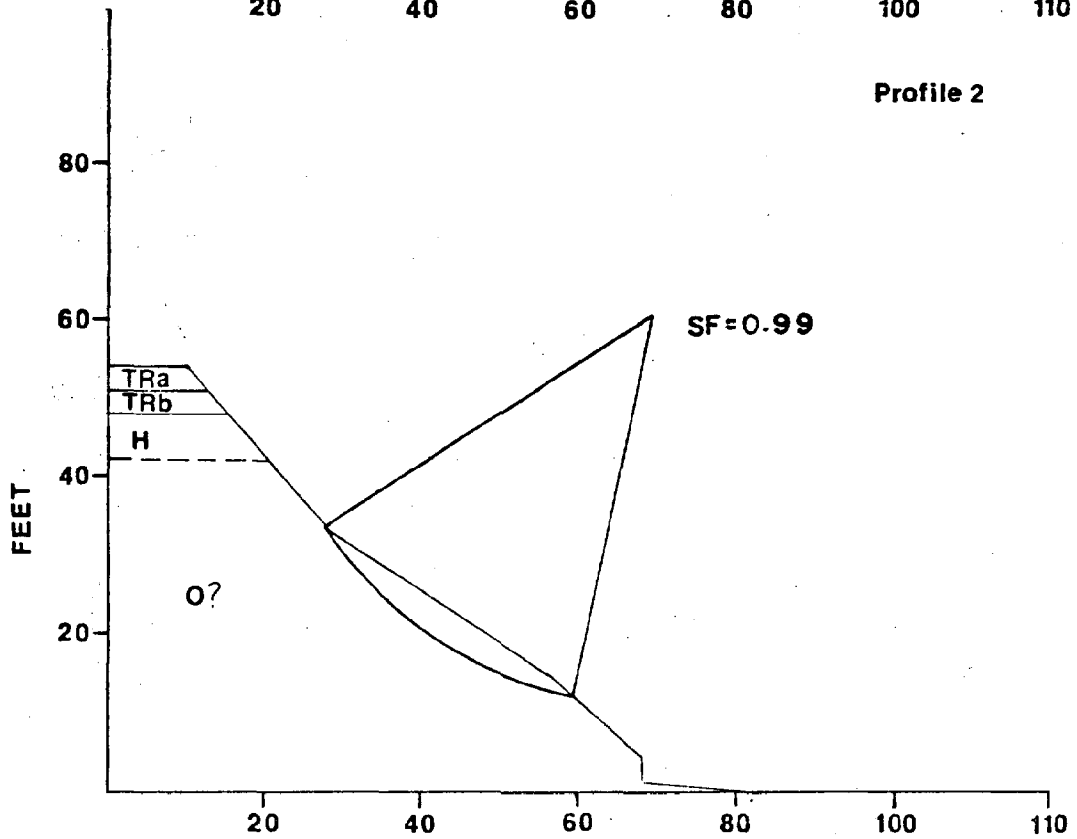


T24 N, R25 E, Sec. 28/29

Profile 1

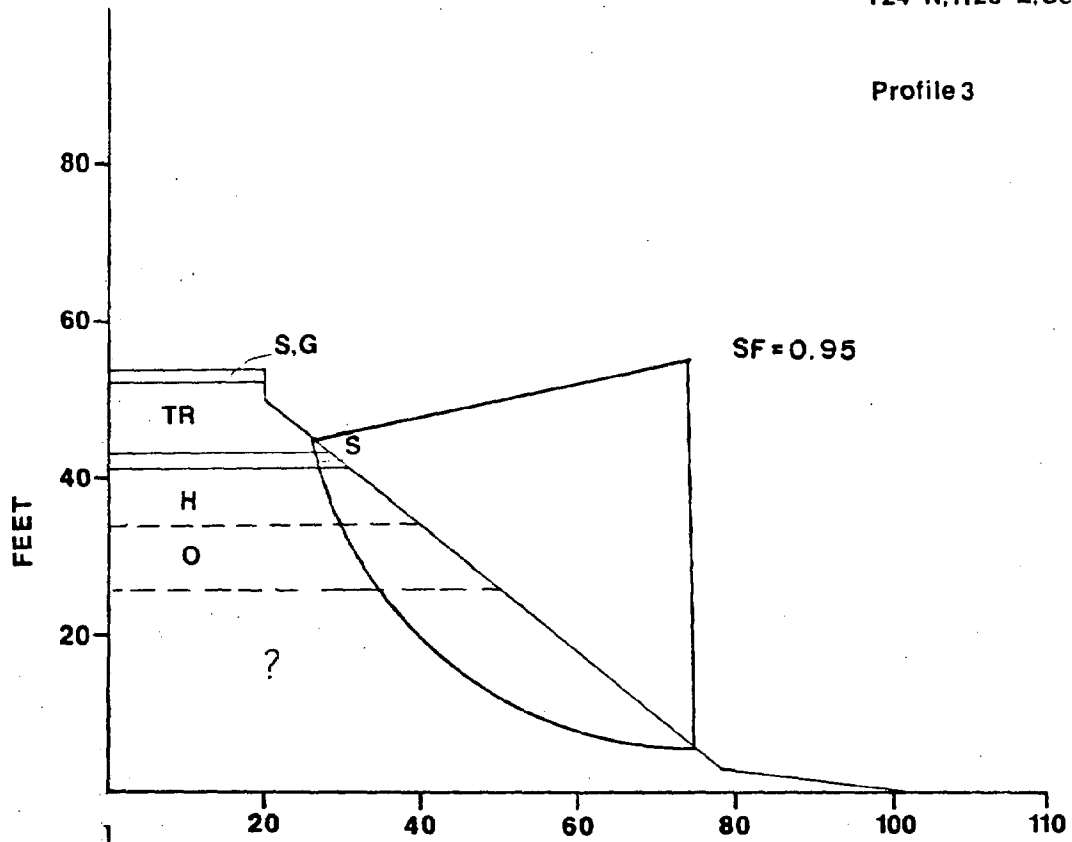


Profile 2

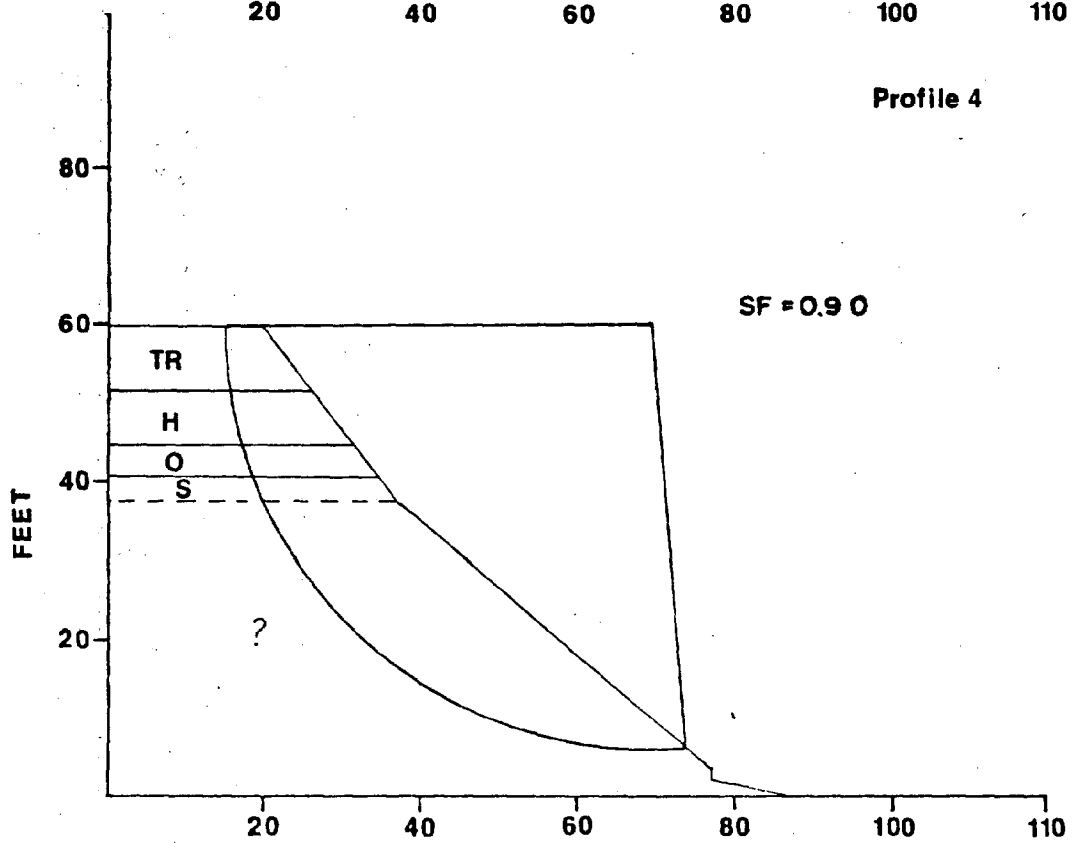


T24 N, R25 E, Sec. 28/29

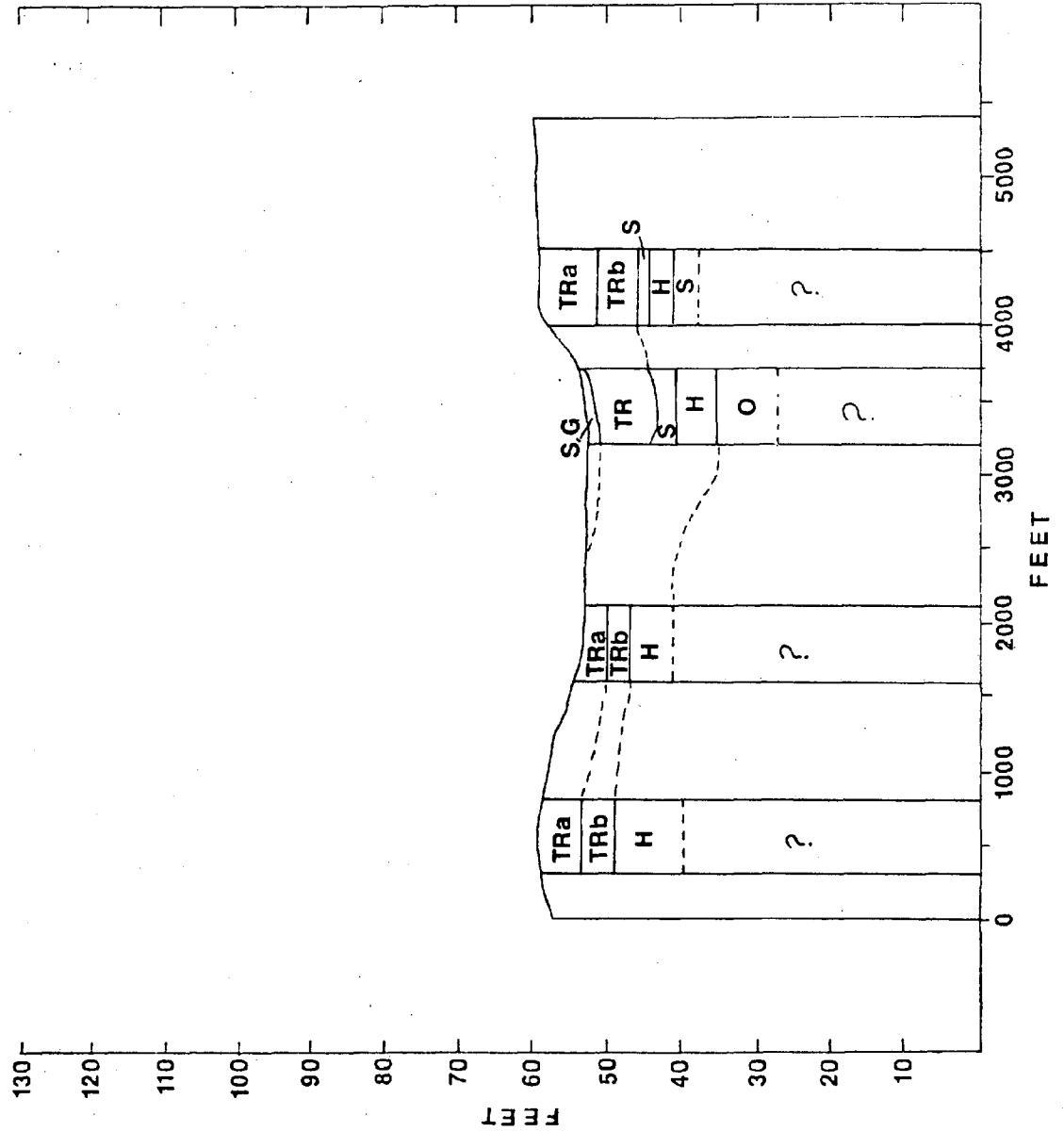
Profile 3



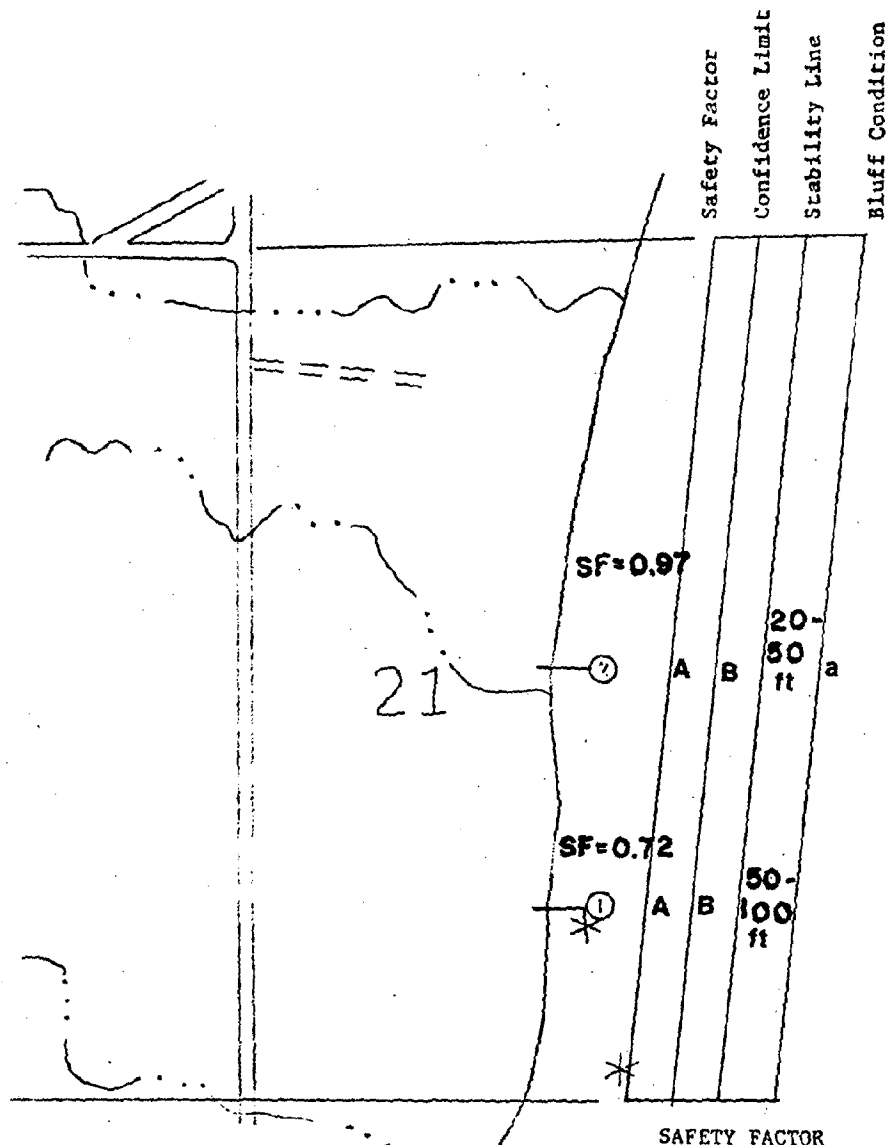
Profile 4



T24N, R25E, SEC. 28/29



T. 24N, R. 5E  
(P. 10000)



#### SAFETY FACTOR

A-less than 1.00

B-1.00 to 1.25

C-greater than 1.25

#### CONFIDENCE LEVEL

A-boreholes

(high confidence)

B-near boreholes

stratigraphy visible

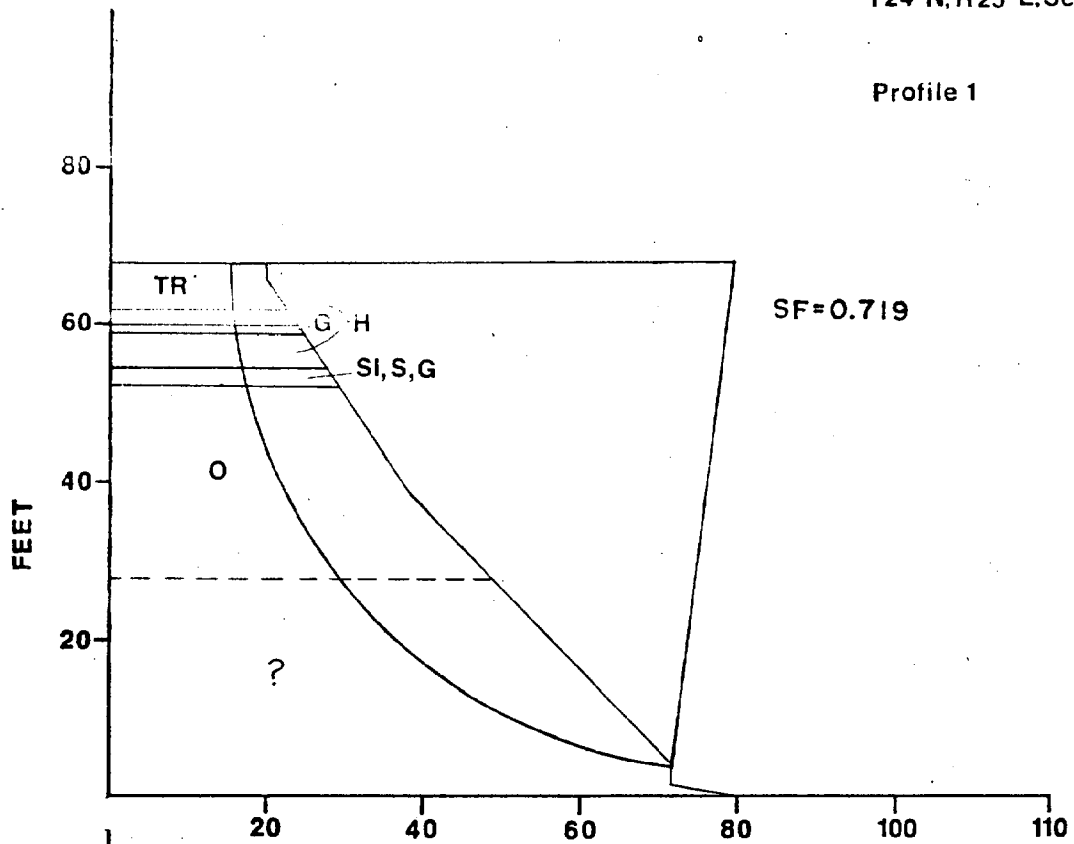
C-no stratigraphy

visible (low

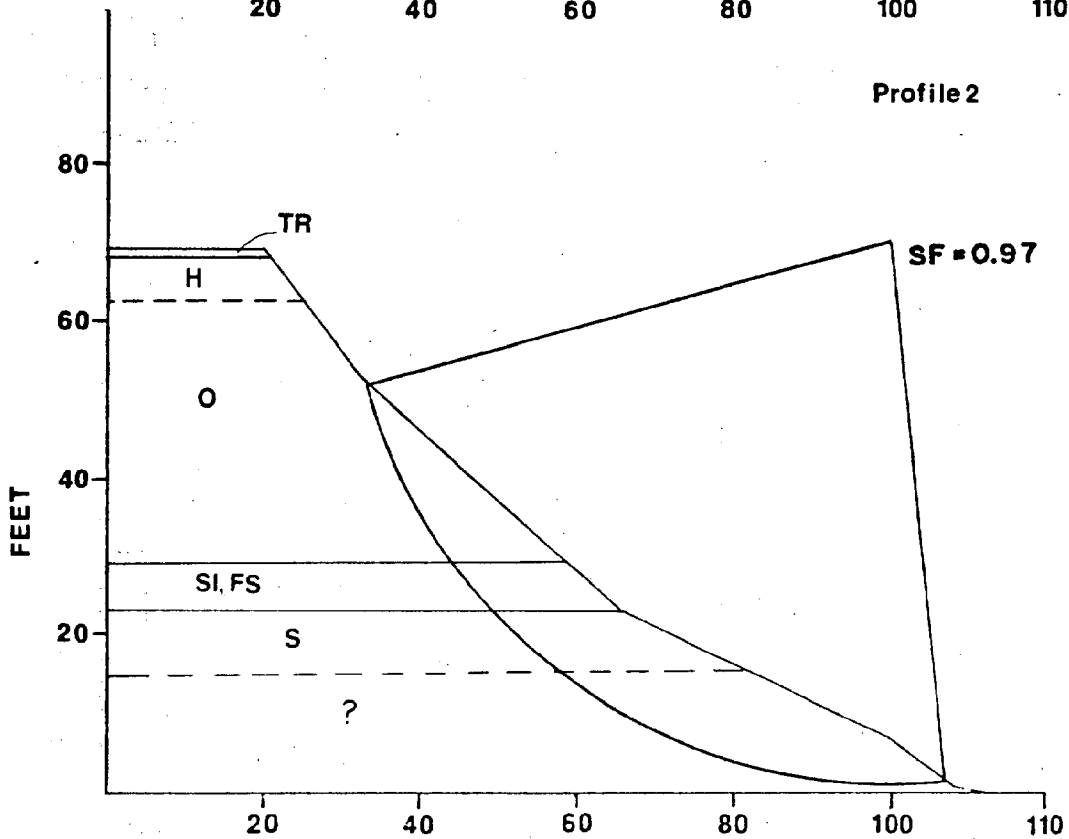
confidence)

T24 N, R25 E, Sec. 21

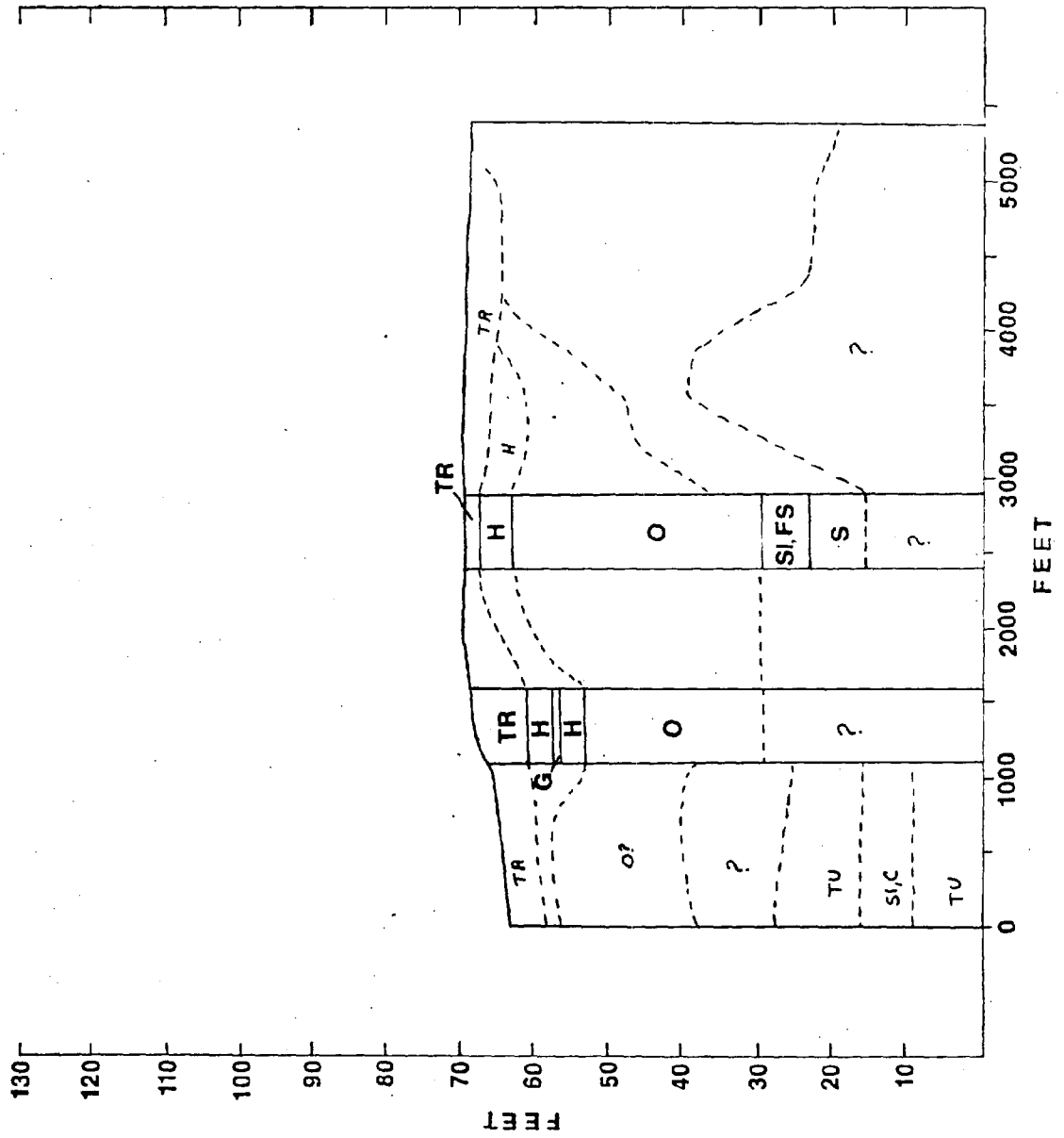
Profile 1



Profile 2



T4N, R25E, SEC. 21



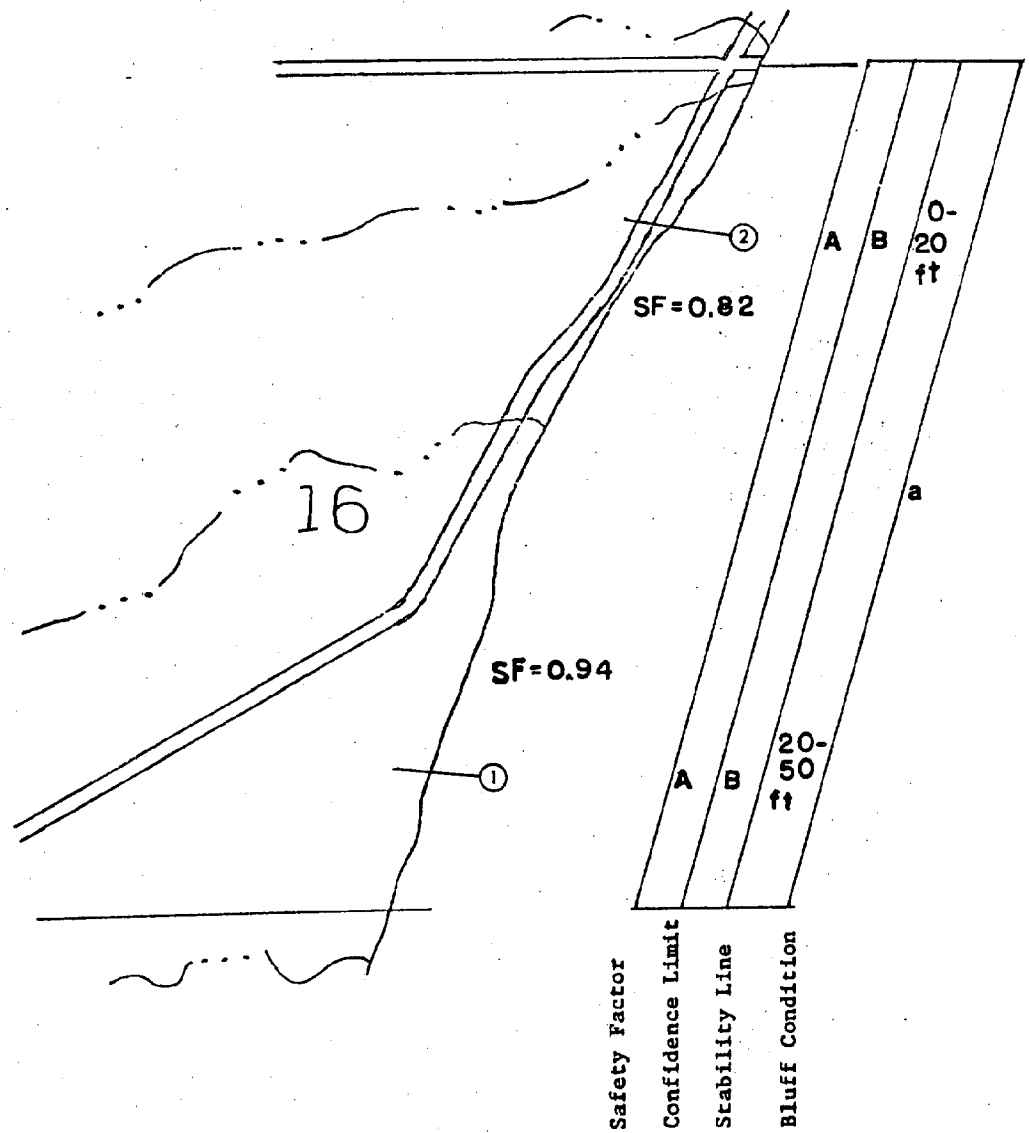
T.24N.R.25E  
(H.6.000)

SAFETY FACTOR

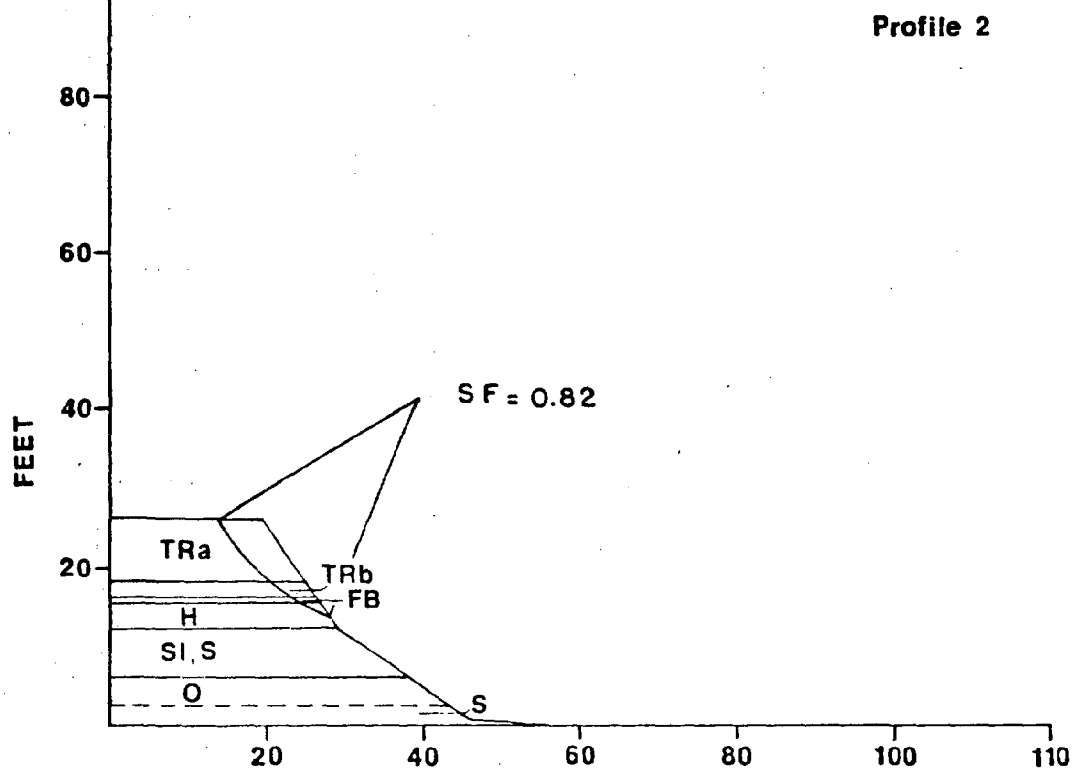
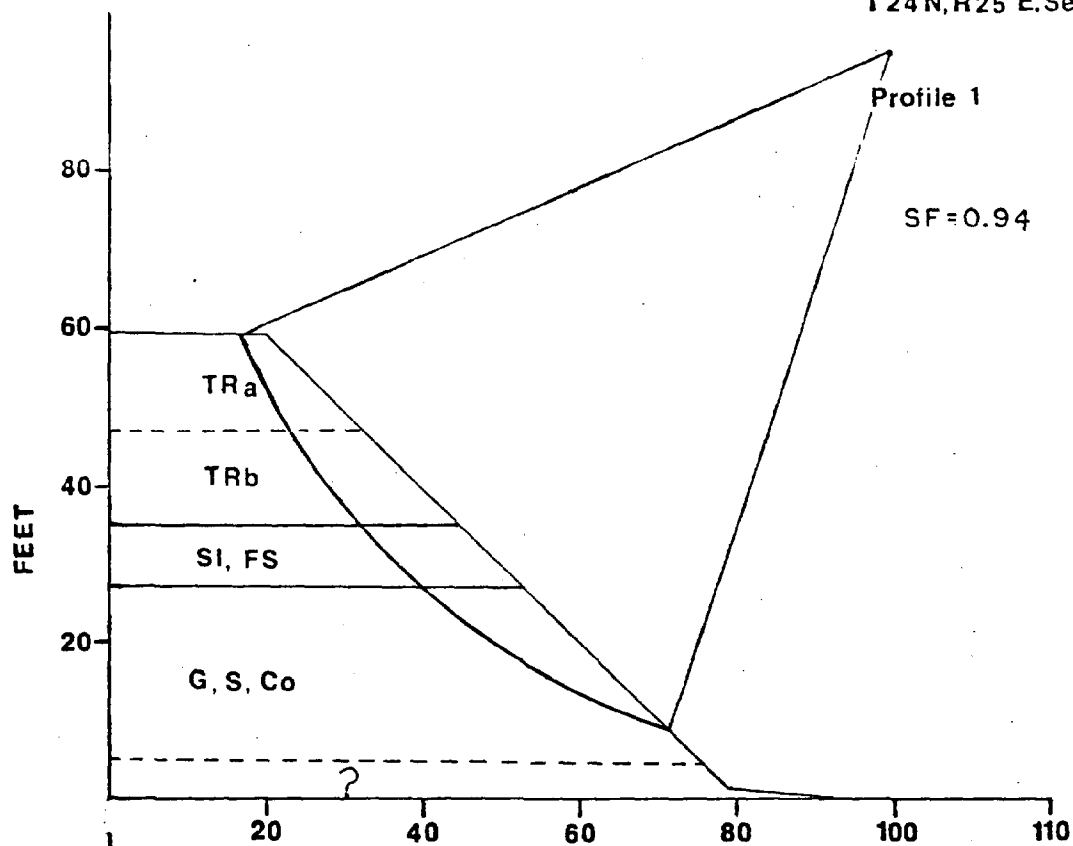
- A-less than 1.00
- B-1.00 to 1.25
- C-greater than 1.25

CONFIDENCE LEVEL

- A-boreholes  
(high confidence)
- B-near boreholes  
stratigraphy visible
- C-no stratigraphy  
visible (low  
confidence)

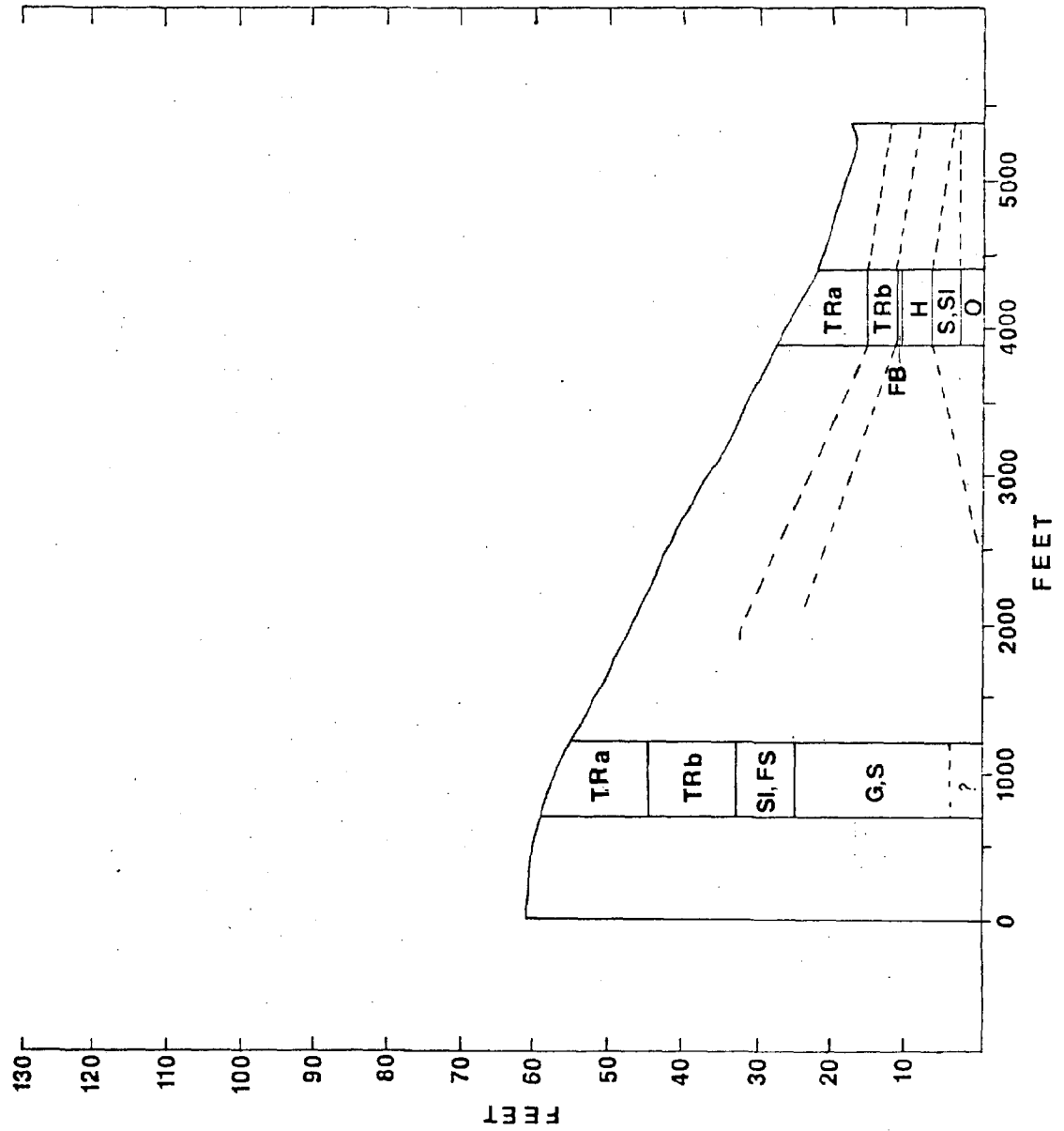


T24 N, R25 E, Sec. 16

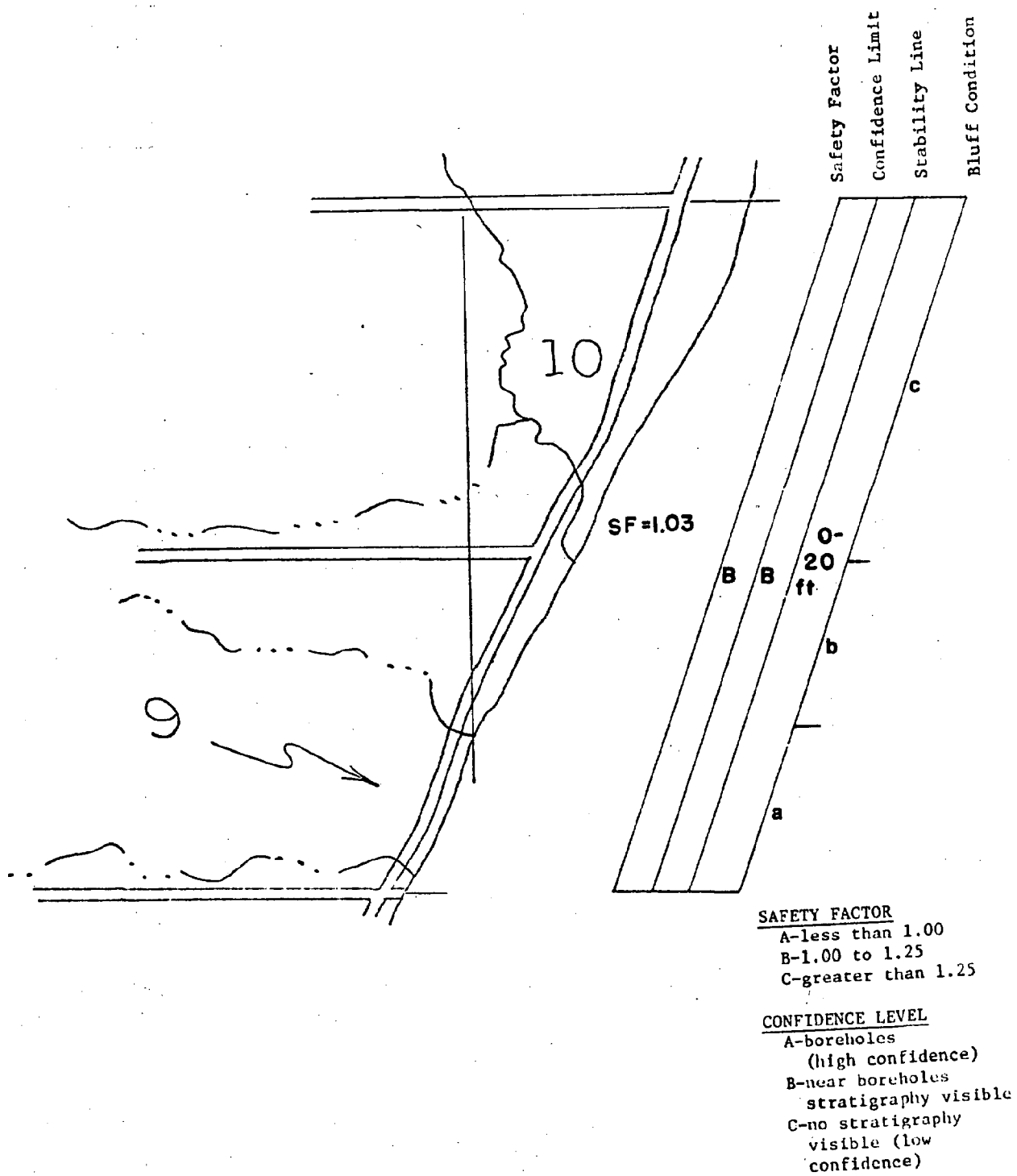




## T24N, R25, SEC. 16

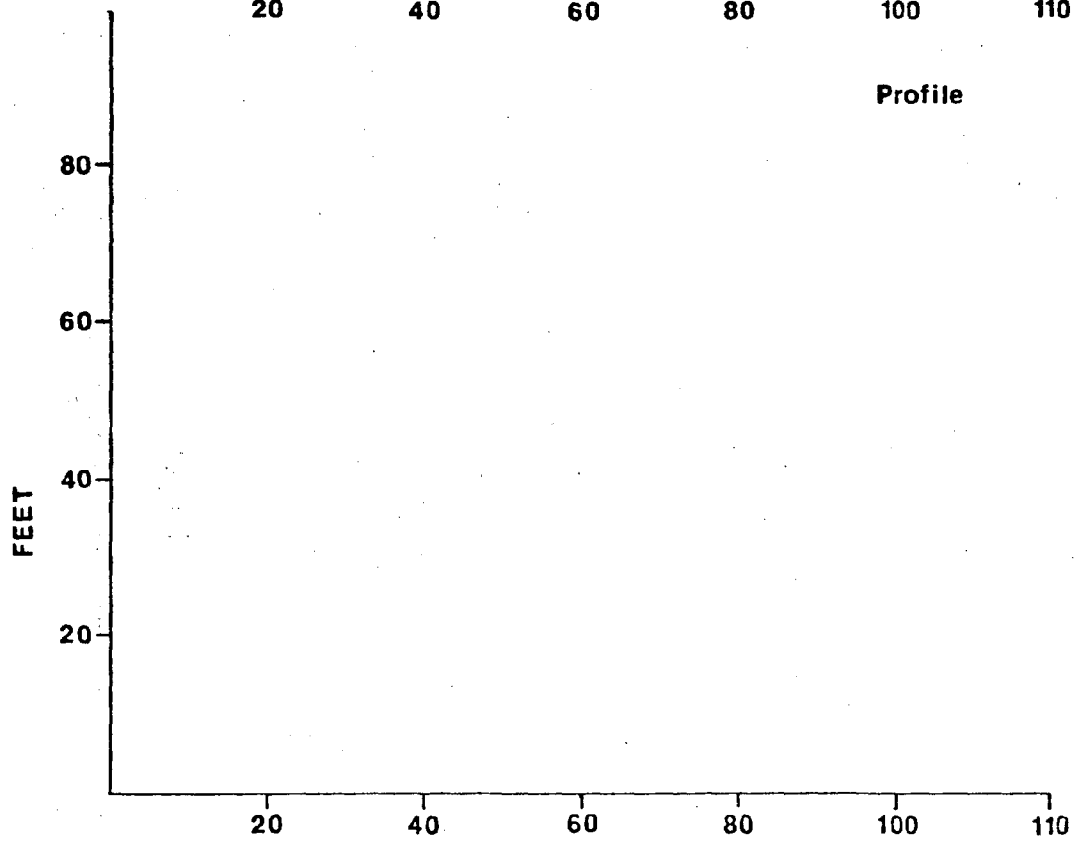
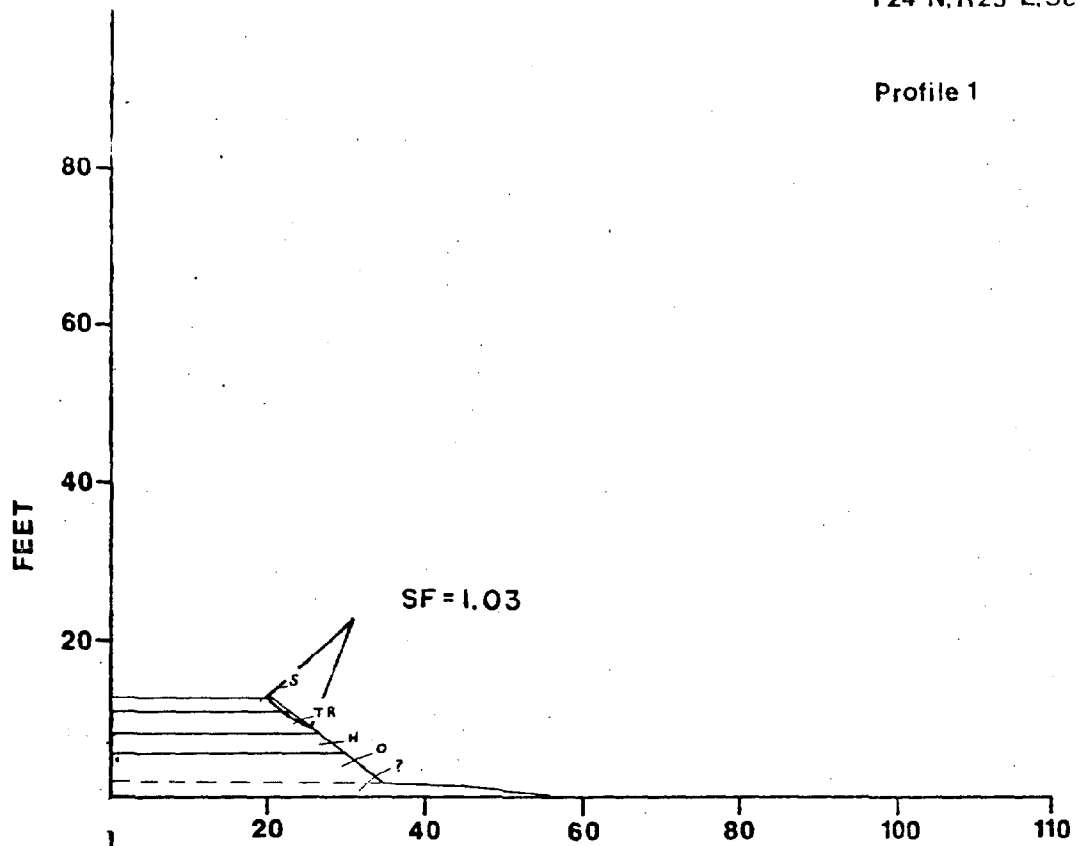


T24N, R25E  
 (P-16.000)

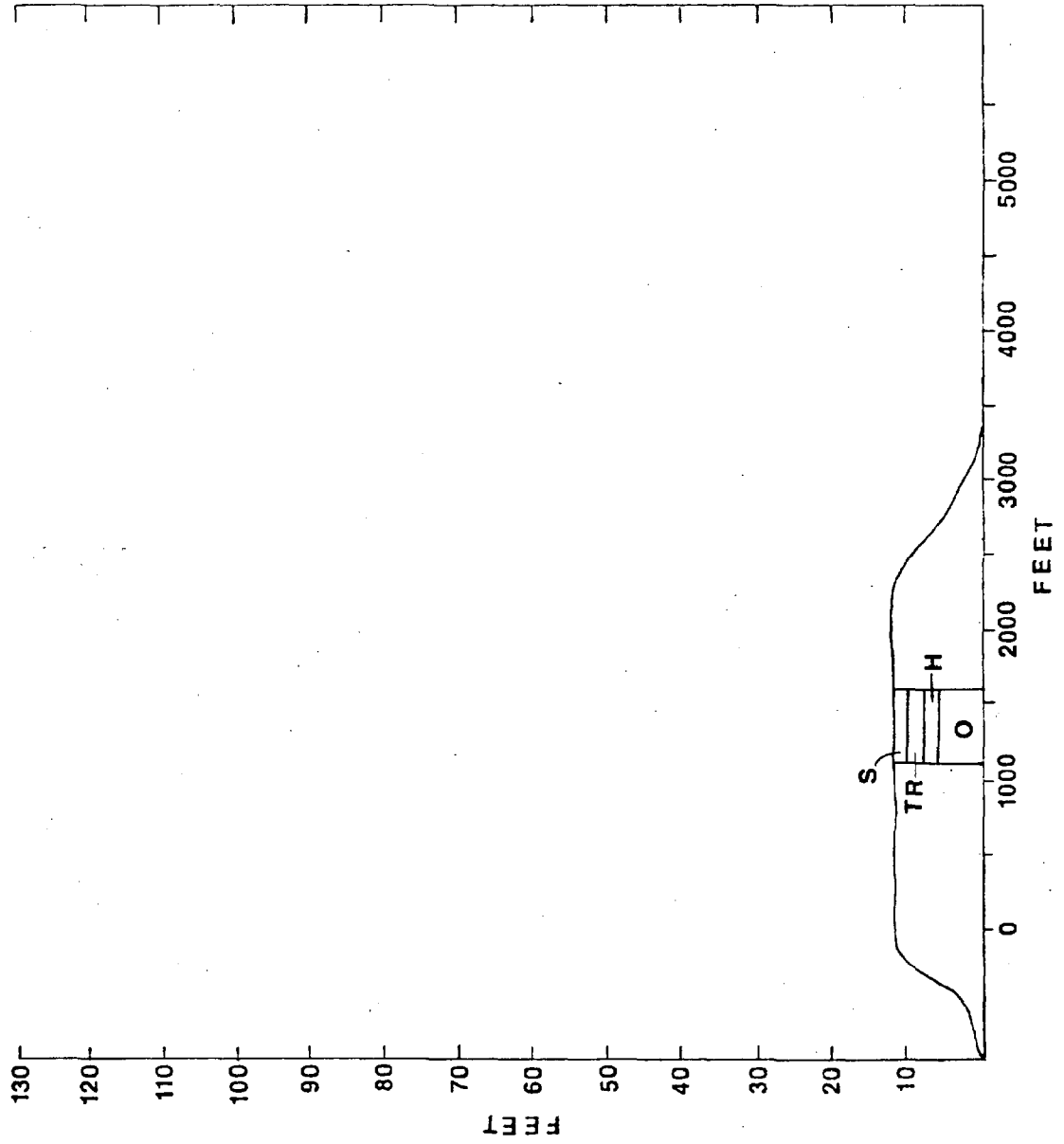


T24 N, R25 E, Sec. 10

Profile 1

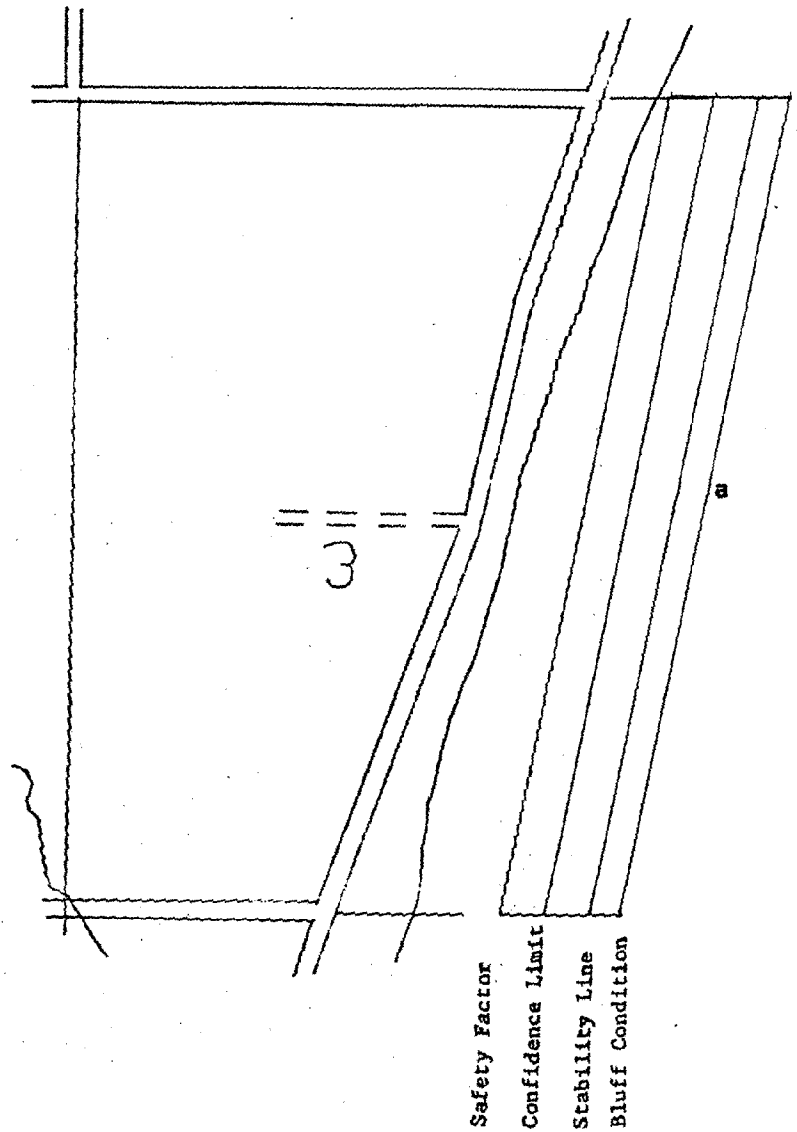


T24, R25, SEC. 10



A-less than 1.00  
B-1.00 to 1.25  
C-greater than 1.25

A-boreholes  
(high confidence)  
B-near boreholes  
stratigraphy visible  
C-no stratigraphy  
visible (low  
confidence)



T. 25 N., R. 25 E.

Most of the shoreline (a, c) is characterized by sand beaches 20 to 70 feet wide built upon a low, flat terrace surface. In some areas the beach is separated from the terrace surface by a 5 to 10 foot high sand bank. The terrace has been largely cleared of vegetation and made into home sites.

The only bluff is approximately 30 feet high and occurs on a rocky point in the middle one third (b) of the section. The slope is 90 percent tree-covered.

T. 25 N., Sec. 26

Sec. 26 can be divided into two subsections. The southern half (a) contains no bluff. At its southern end is a 50 foot wide sand beach. The beach width diminishes to 30 feet near the southern breakwater of Algoma harbor. Between the breakwaters and adjacent to the harbor mouth there is no bluff, only a low bank protected by rip-rap.

The northern subsection (b) begins less than one-tenth of a mile north of the northern breakwater. The subsection contains bluffs up to 40 feet high (shown on Section 26/23). Vegetation ranges from 0 percent at the south end of the subsection, to nearly 100 percent at the north. Bluff stratigraphy includes a 6 foot cap of red, stoney till over red-brown clayey till (Haven). The beach ranges in width from 5 to 35 feet and consists primarily of sand to the south and cobbles and boulders to the north and on the small points.

T. 25 N., Sec. 23/24

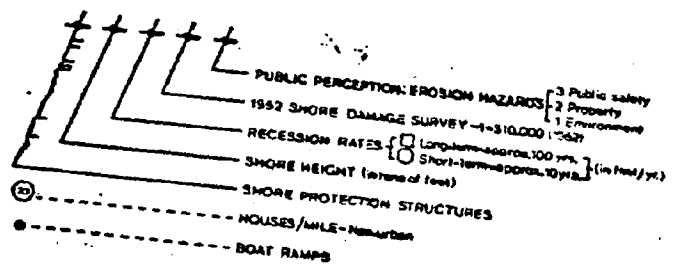
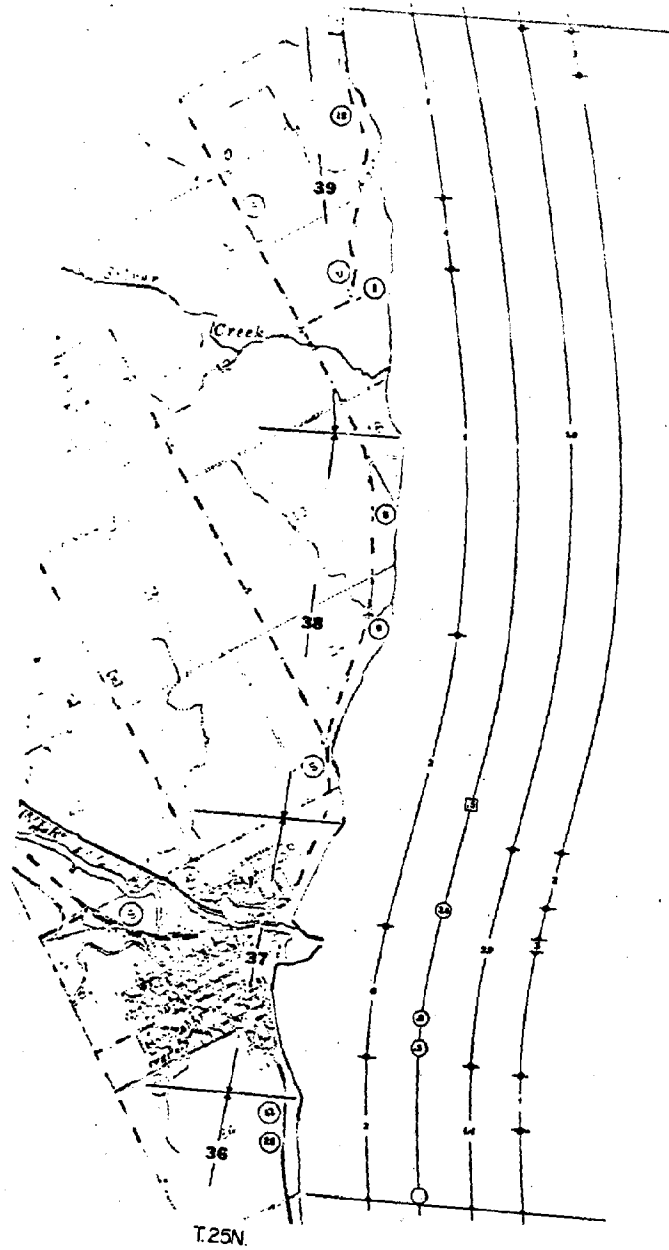
Section 23/24 can be divided into two subsections. The southern two-tenths of the section (a) contains 40 foot high bluffs which are 0 to 20 percent vegetated. The beach is 0 to 15 feet wide and consists of sand with cobbles.

The balance of section 23/24 (b) is a flat, sandy terrace. The terrace is 5 to 10 feet above lake level and is separated from the beach in some areas by a 5 to 10 foot bank. Some minor failures occur along this bank. The beach is 5 to 35 feet wide and is primarily composed of sand or sand with pebbles.

T. 25 N., Secs. 13, 18, 7, and 6

The shoreline in these sections can be characterized by sand beaches, 20 to 70 feet wide developed on a flat, sandy terrace surface. About half of the terrace surface is wooded. The beach is occasionally separated from the terrace by a 5 to 15 foot high sand bank. In a few places this bank is subject to direct wave attack.

The only significant bluff occurs in the northern one-third of section 7 on a rocky point. The bluff is approximately 30 feet high and is 90 percent tree-covered. The only shore protection structure present is approximately 1,000 feet of rip-rap protecting a 10 foot bank at the extreme northern end of section 6 where county road U makes a close approach to the lake.





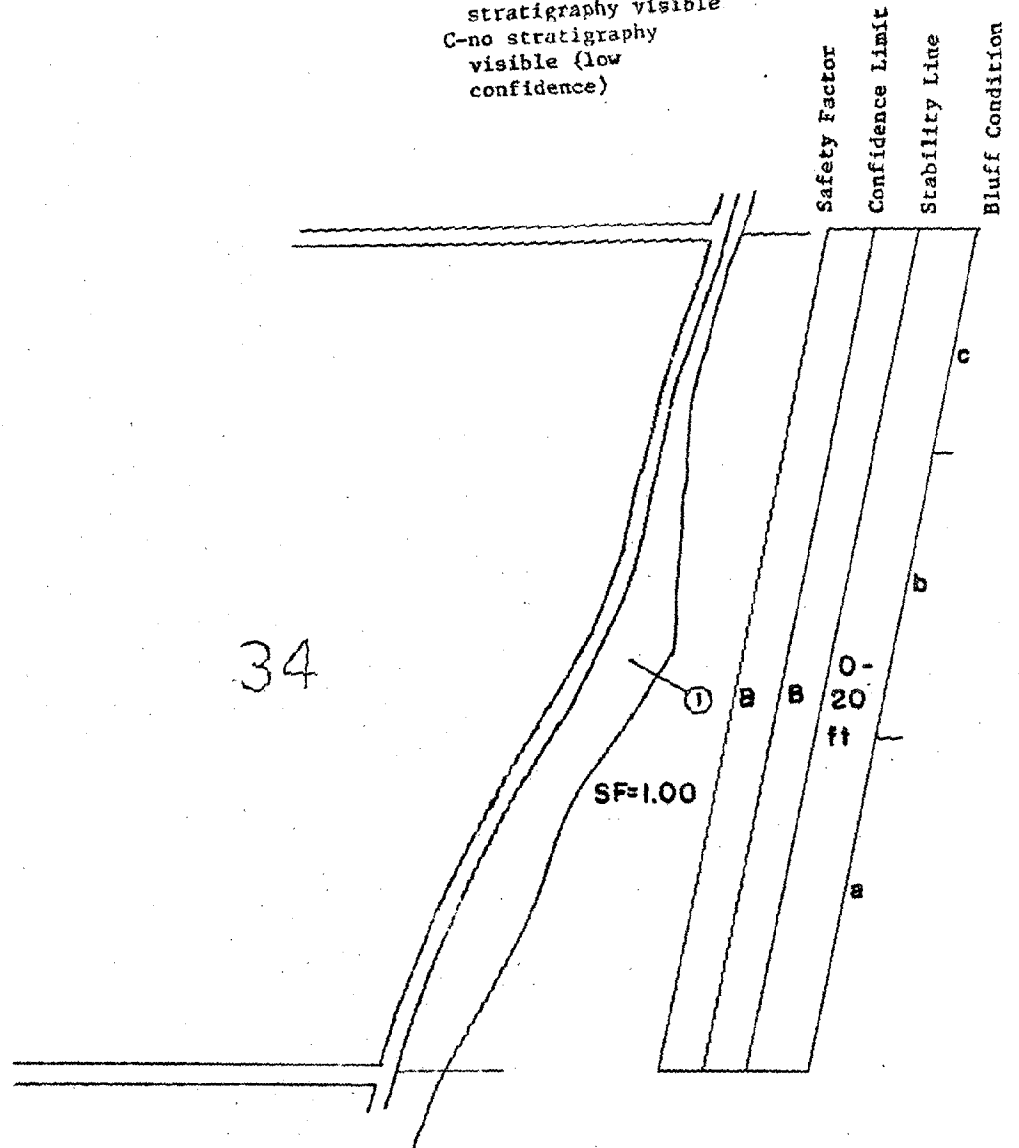
T. 25N, R. 25E.  
(R.L.S. 300A)

SAFETY FACTOR

- A-less than 1.00
- B-1.00 to 1.25
- C-greater than 1.25

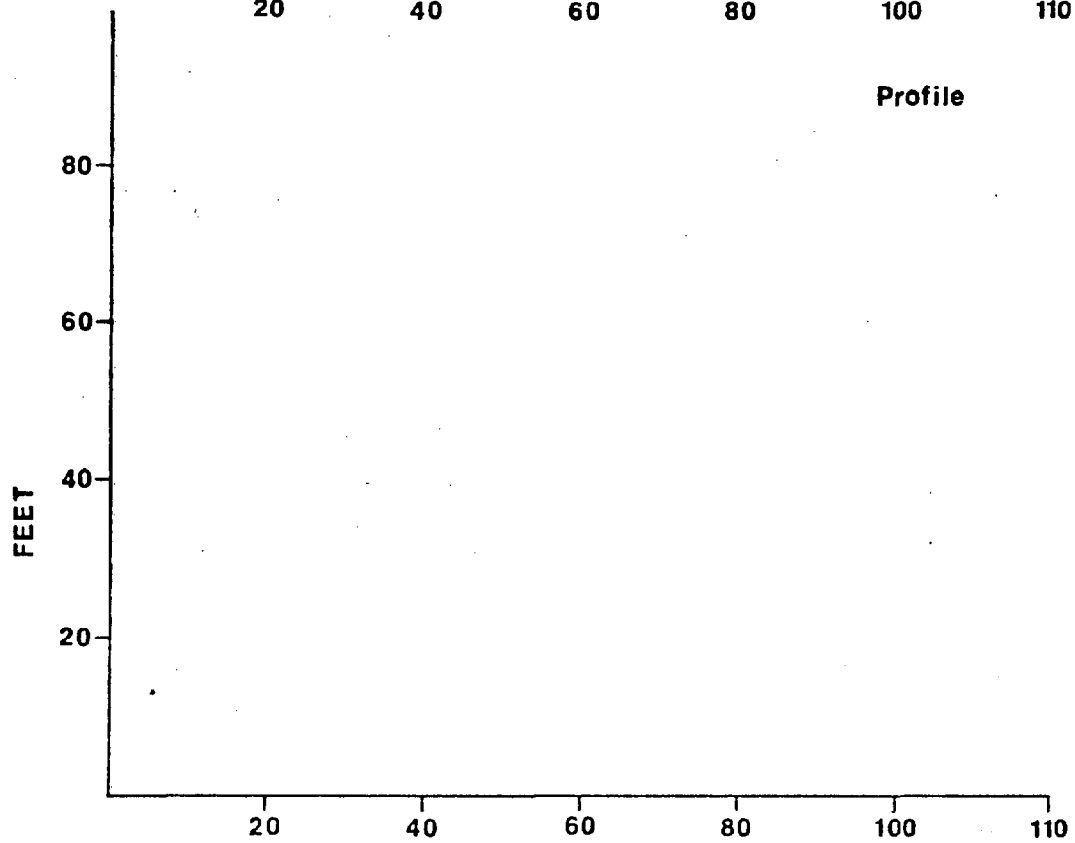
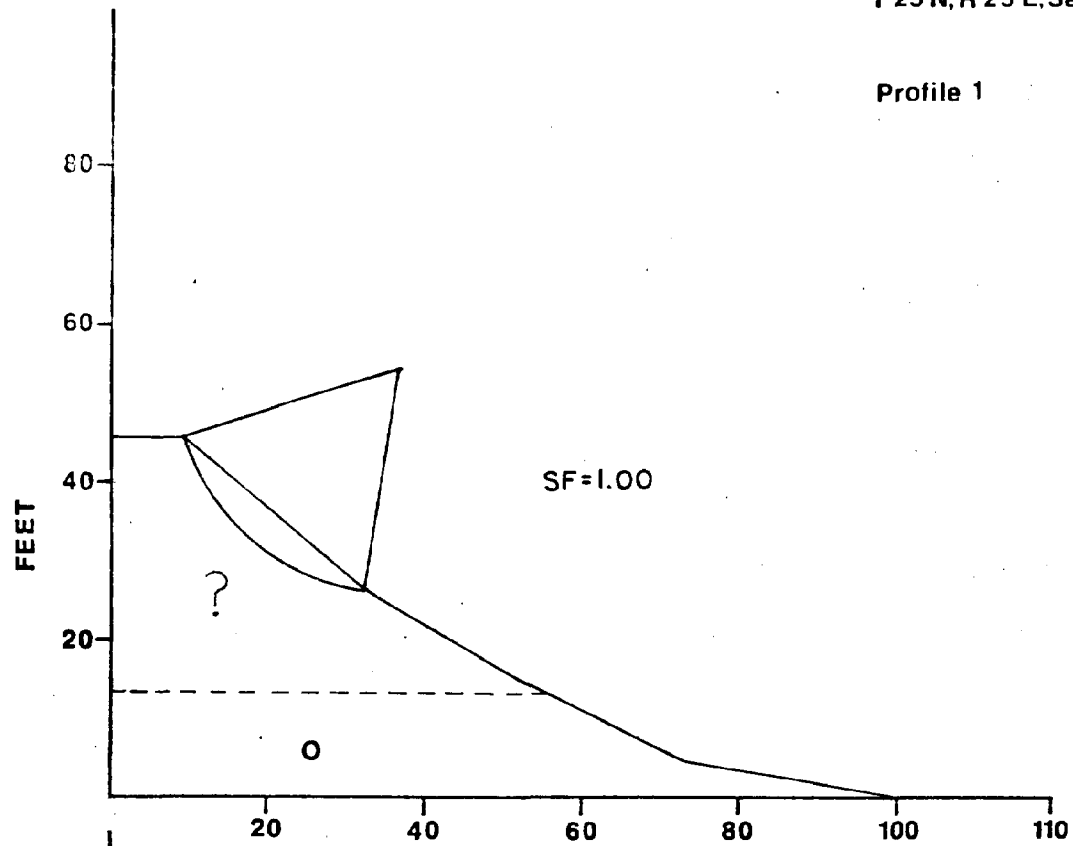
CONFIDENCE LEVEL

- A-boreholes  
(high confidence)
- B-near boreholes  
stratigraphy visible
- C-no stratigraphy  
visible (low confidence)

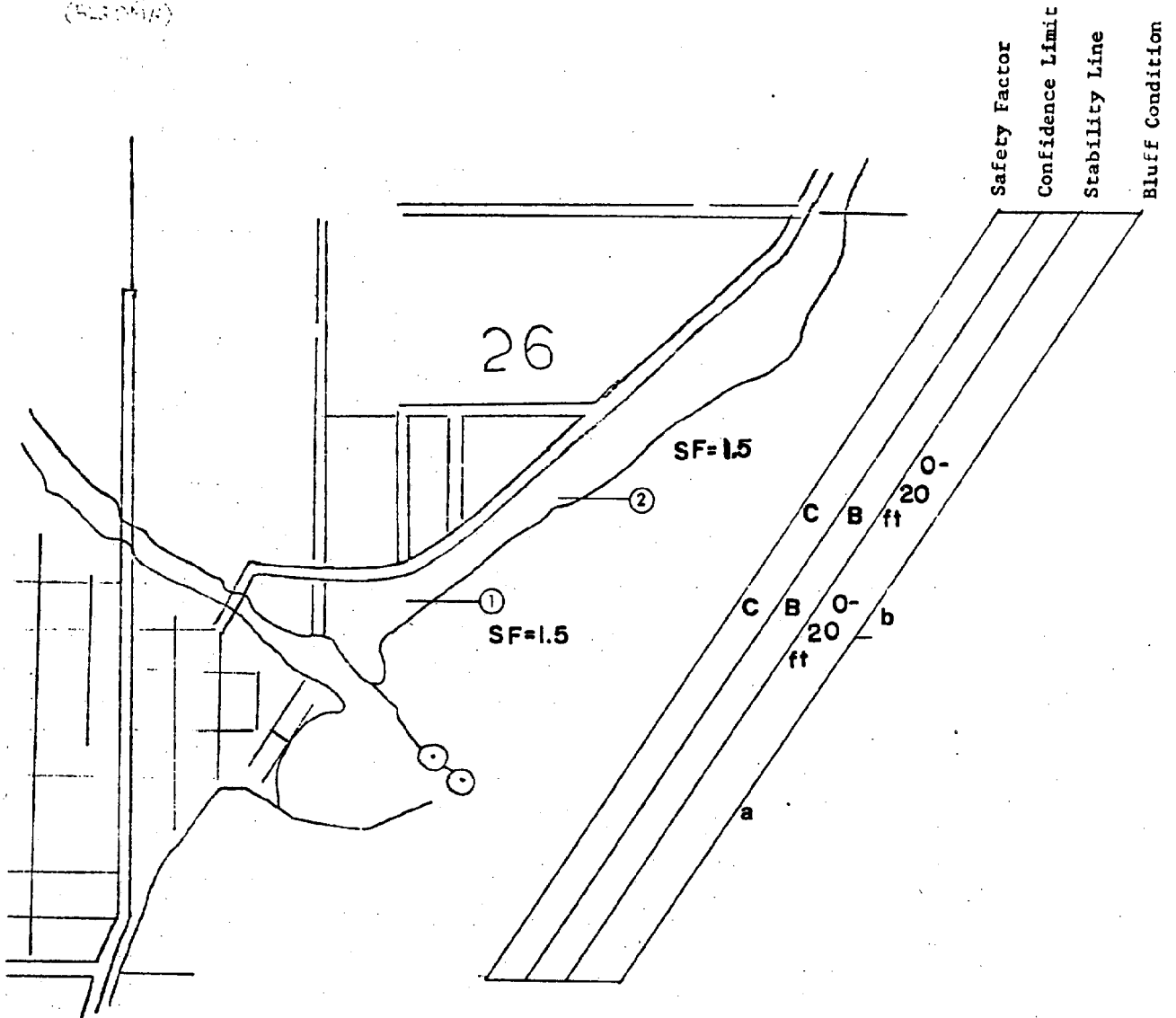


T 25 N, R 25 E, Sec. 34

Profile 1



T.25N., R.25E.  
(BLISS/4)



**SAFETY FACTOR**

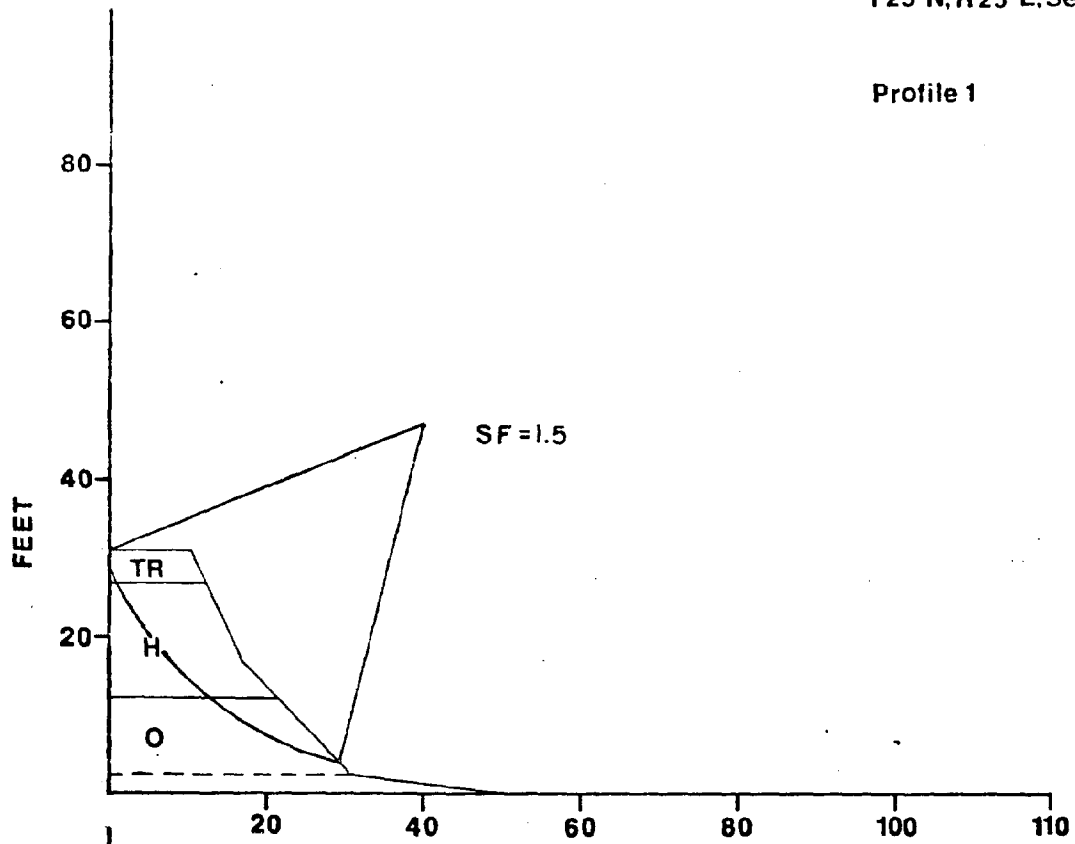
- A-less than 1.00
- B-1.00 to 1.25
- C-greater than 1.25

**CONFIDENCE LEVEL**

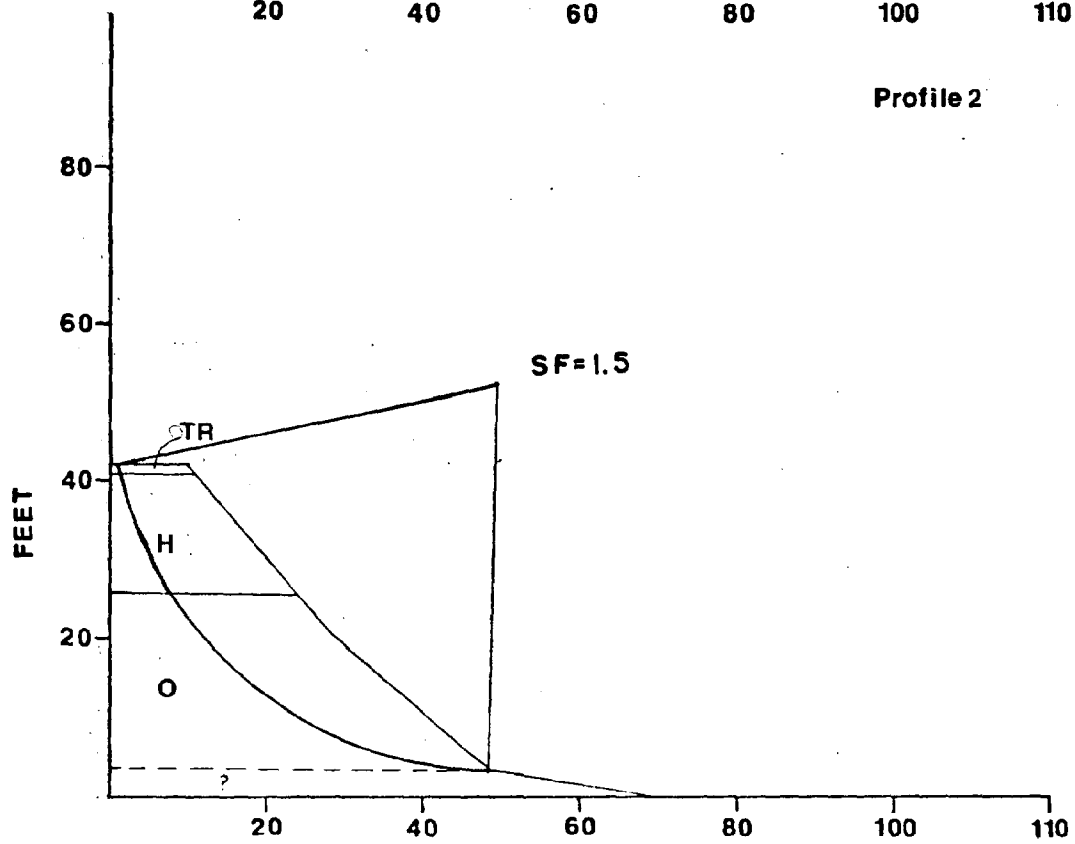
- A-boreholes  
(high confidence)
- B-near boreholes  
stratigraphy visible
- C-no stratigraphy  
visible (low confidence)

T25 N, R25 E, Sec. 26

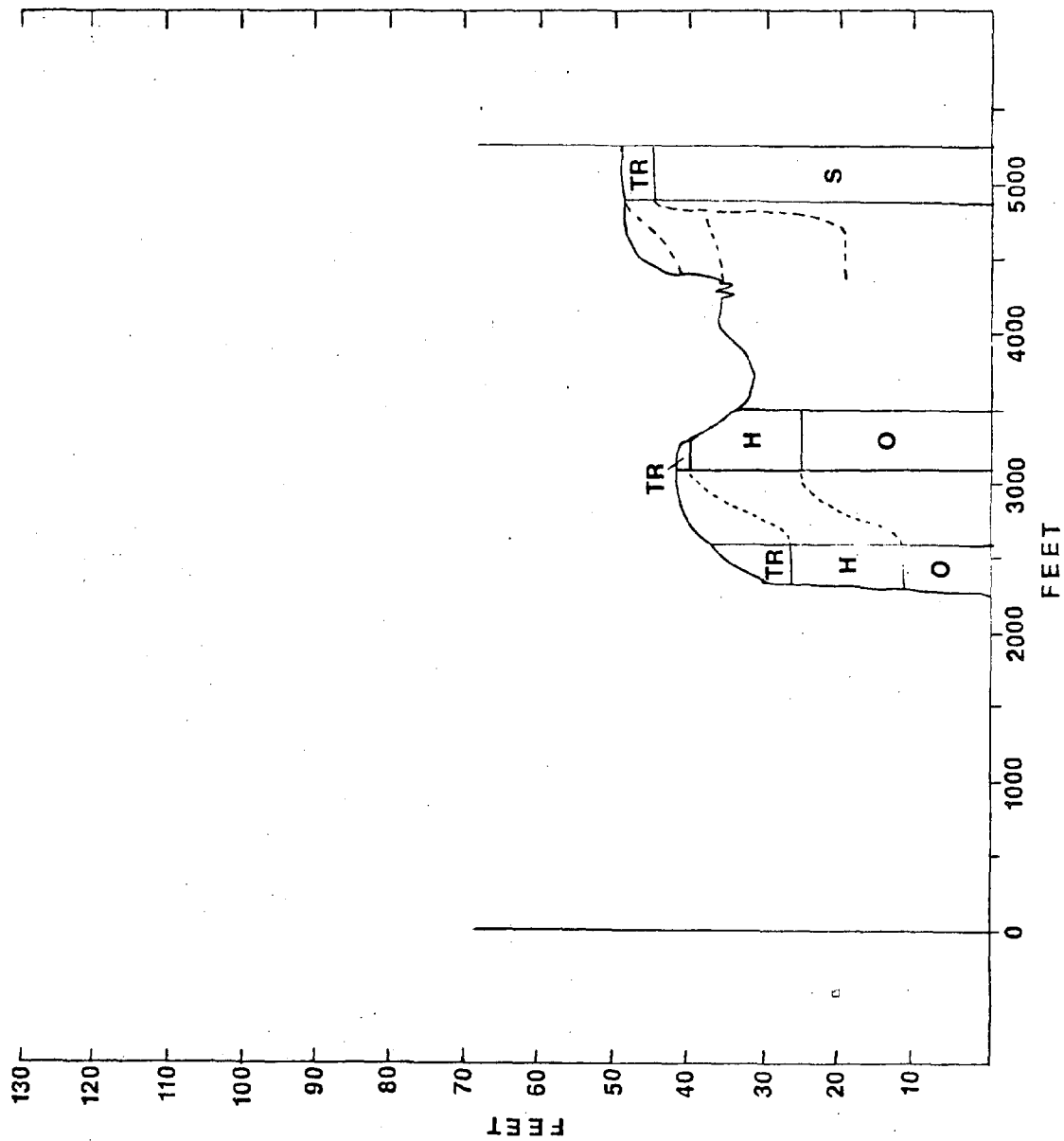
Profile 1



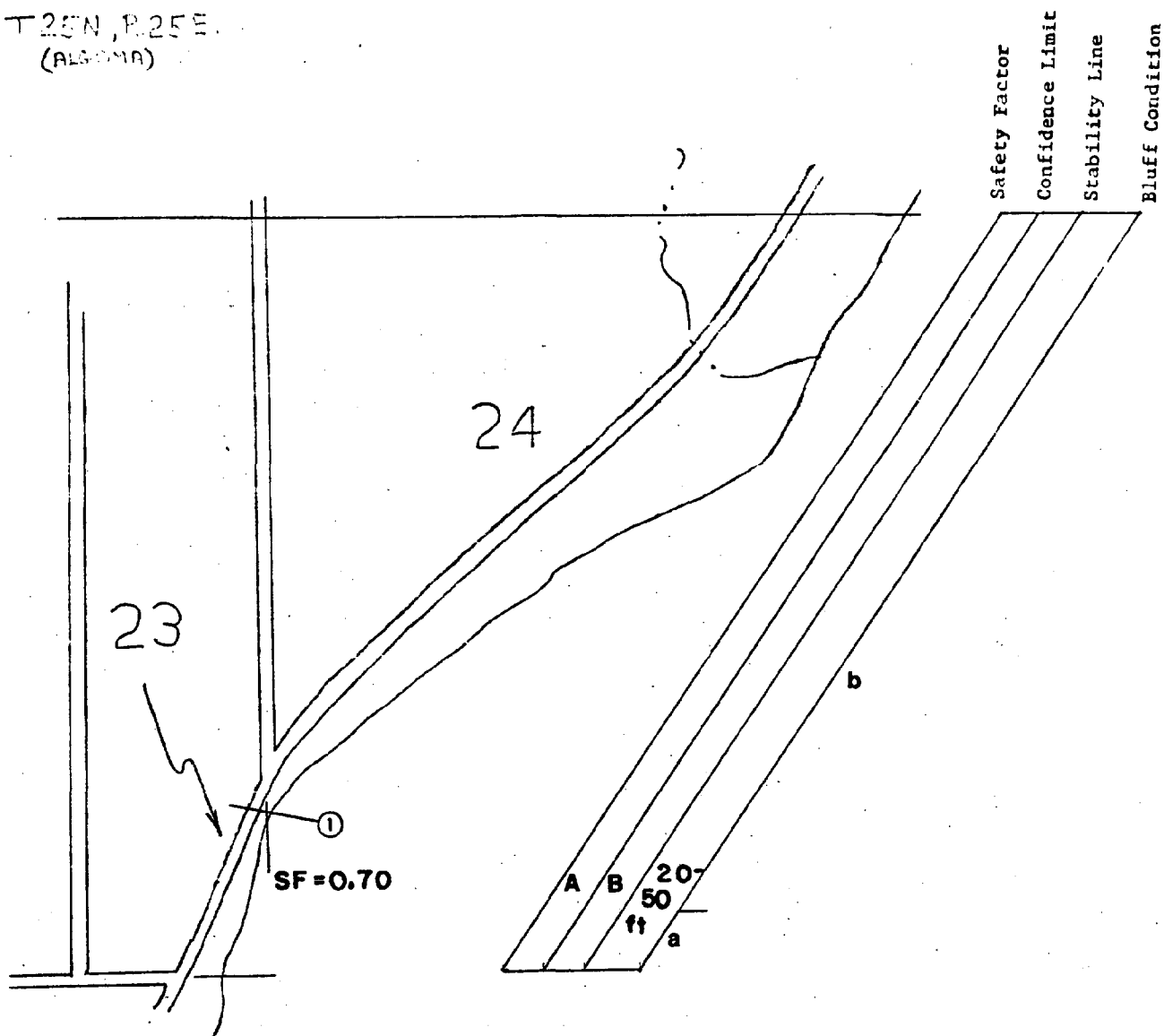
Profile 2



T25N R25E SEC. 26/23



T25N, R25E.  
(ALBANY)

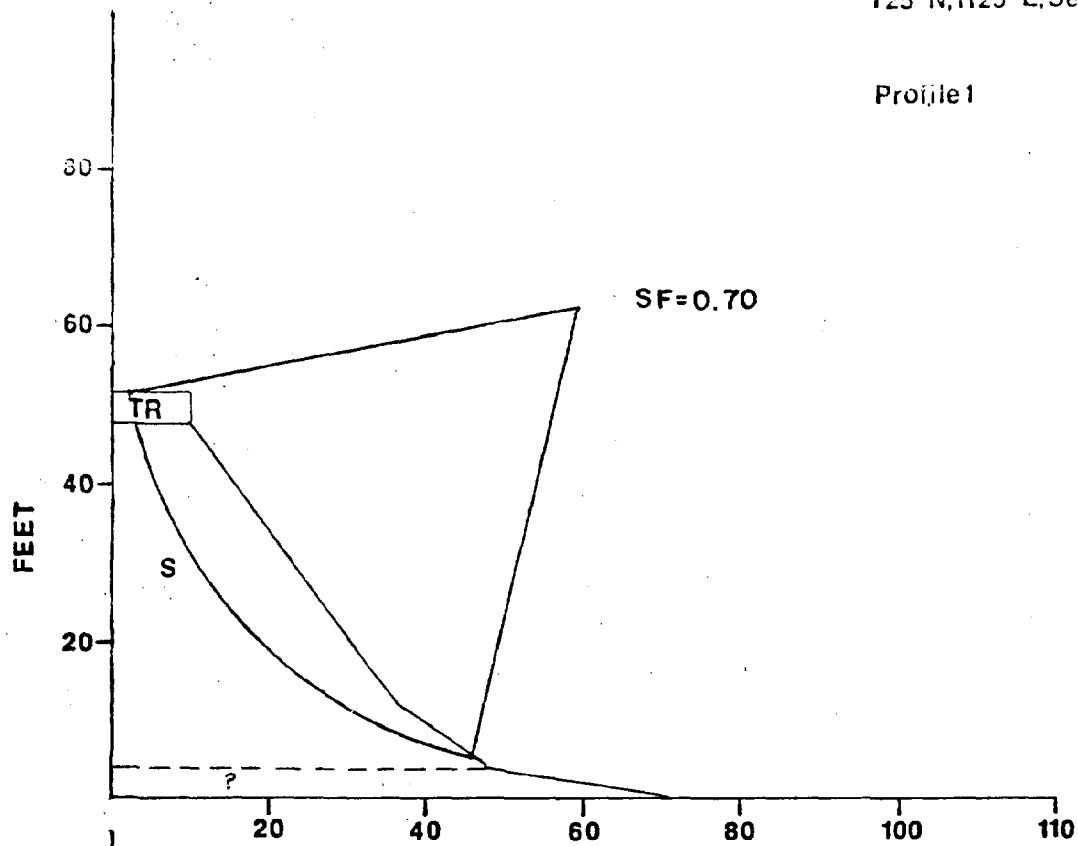


**SAFETY FACTOR**  
 A-less than 1.00  
 B-1.00 to 1.25  
 C-greater than 1.25

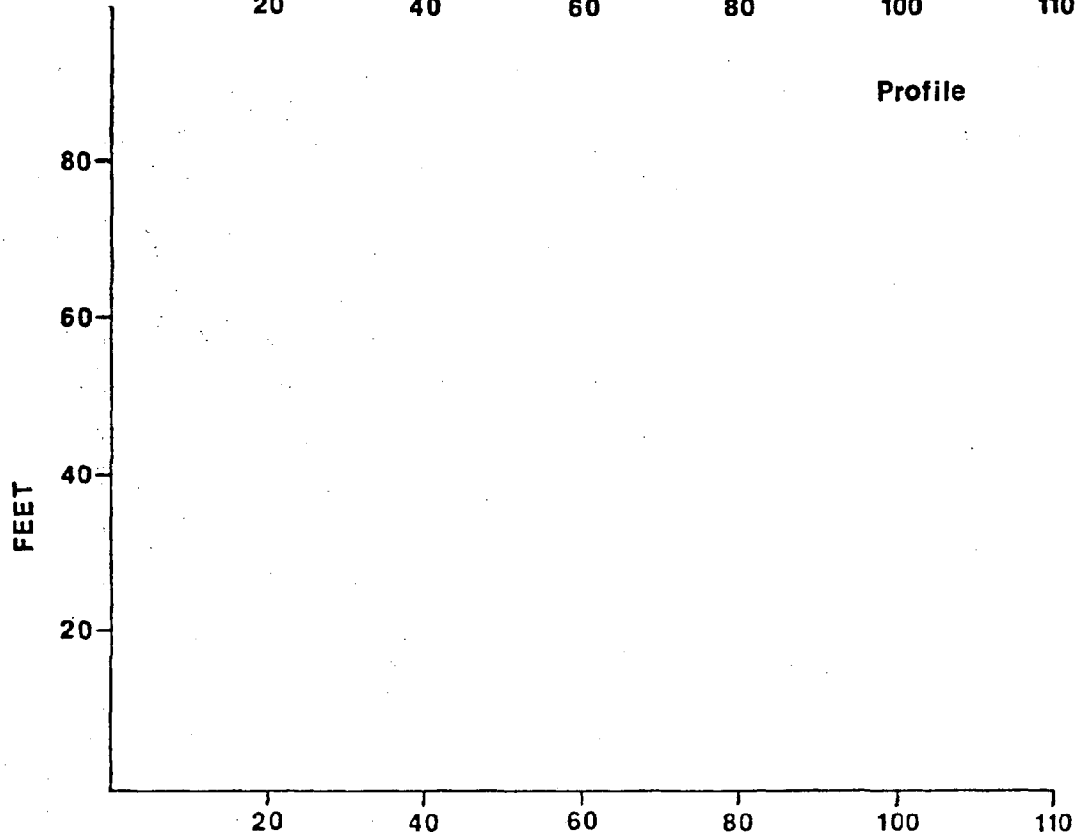
**CONFIDENCE LEVEL**  
 A-boreholes  
 (high confidence)  
 B-near boreholes  
 stratigraphy visible  
 C-no stratigraphy  
 visible (low  
 confidence)

T25 N, R25 E, Sec. 23

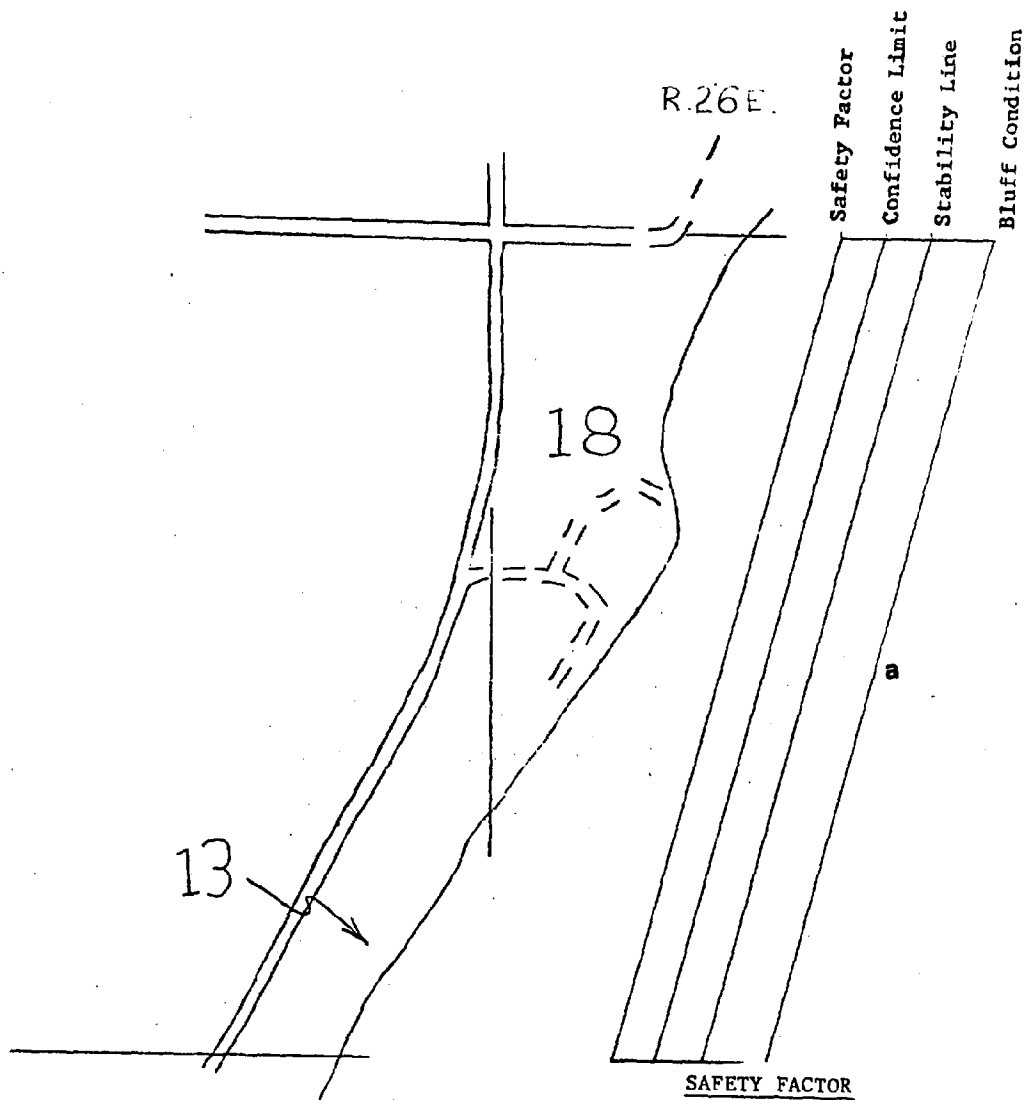
Profile 1



Profile



T.25N, R.25E.  
(H.25N.15)



SAFETY FACTOR

A-less than 1.00

B-1.00 to 1.25

C-greater than 1.25

CONFIDENCE LEVEL

A-boreholes

(high confidence)

B-near boreholes

stratigraphy visible

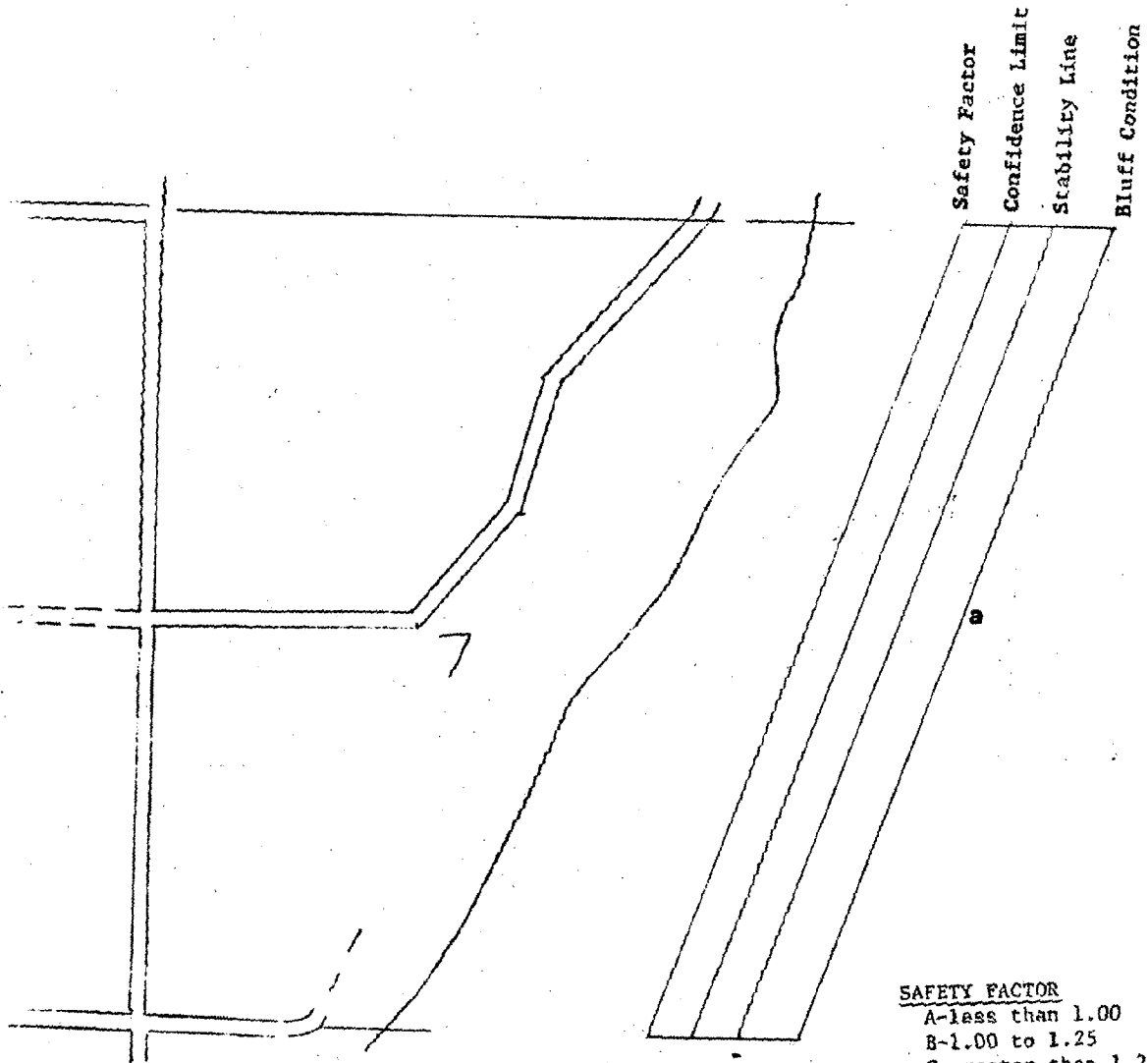
C-no stratigraphy

visible (low

confidence)



T.25N, R.26E.  
(1:250,000)



SAFETY FACTOR

- A-less than 1.00
- B-1.00 to 1.25
- C-greater than 1.25

CONFIDENCE LEVEL

- A-boreholes  
(high confidence)
- B-near boreholes  
stratigraphy visible
- C-no stratigraphy  
visible (low  
confidence)

T. 25 N., R. 26 E.

(f. 2. v. 4)

SAFETY FACTOR

A-less than 1.00

B-1.00 to 1.25

C-greater than 1.25

CONFIDENCE LEVEL

## A-boreholes

(high confidence)

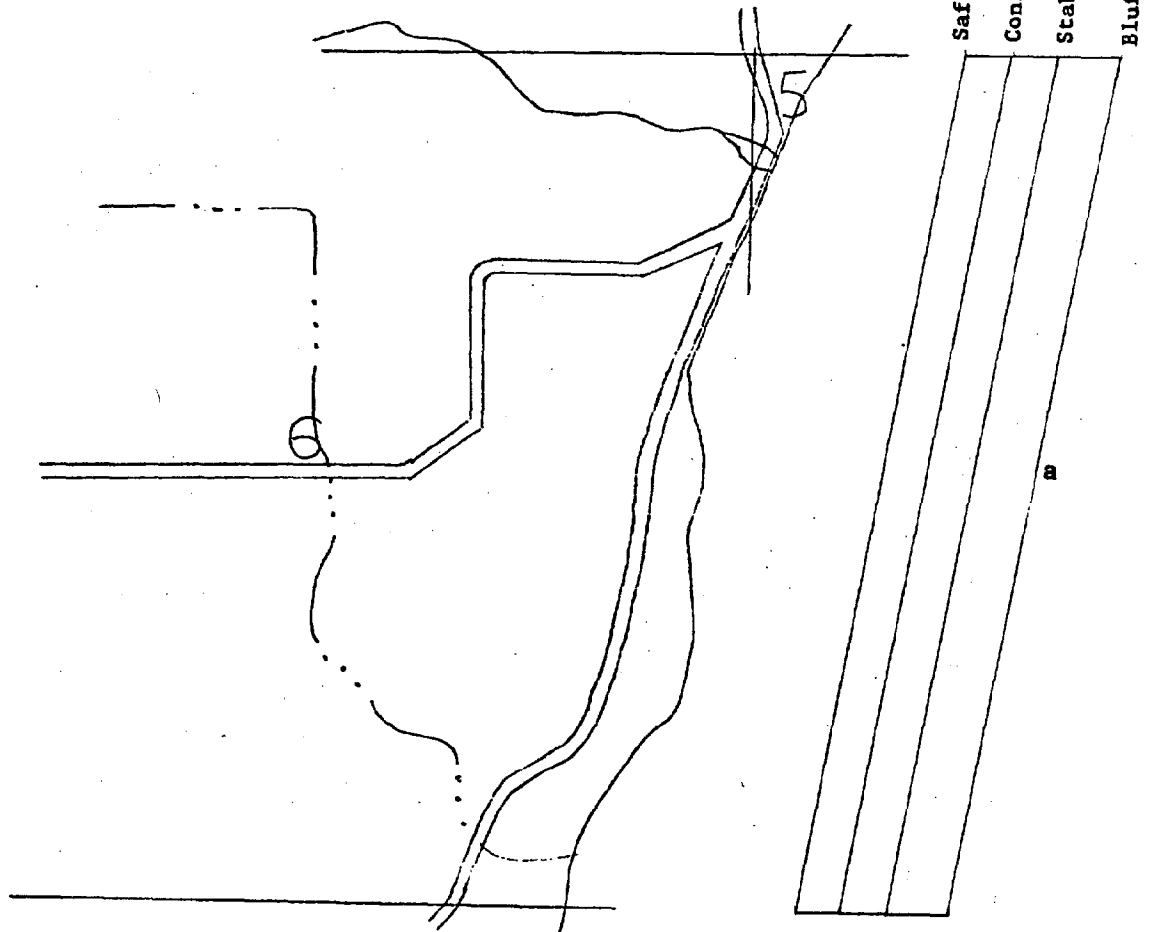
### B-near boreholes

stratigraphy visible

C-no stratigraphy

visible (low

confidence)



T. 26 N., R. 26 E.

## T. 26 N., Sec. 32

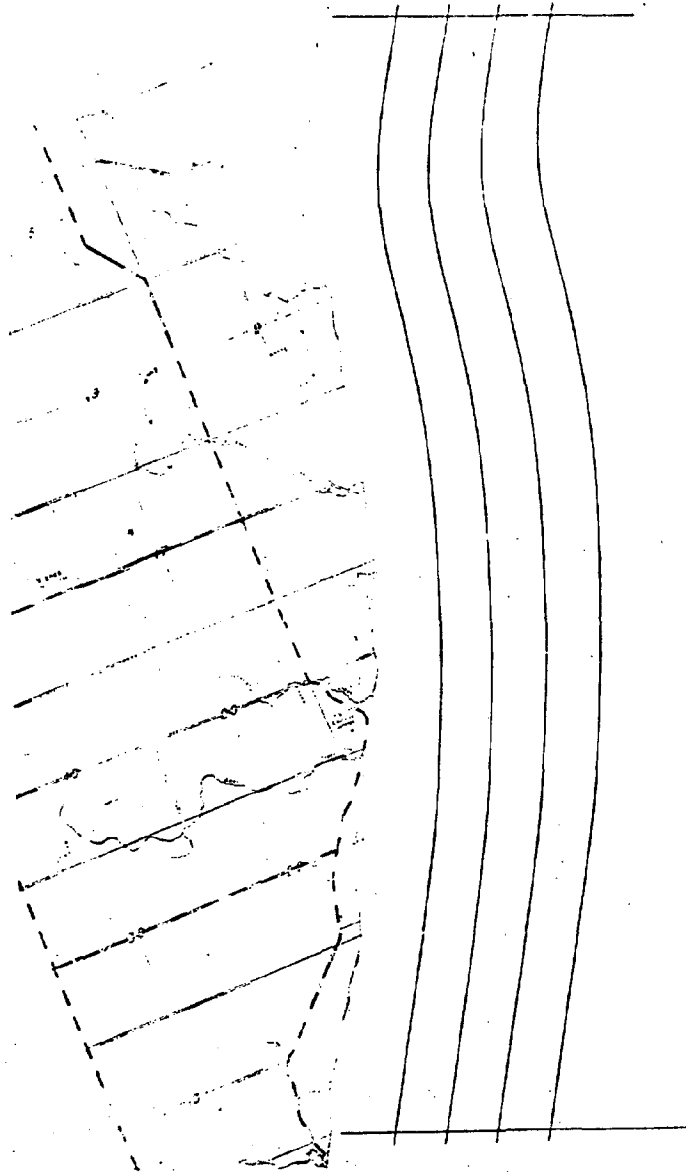
Section 32 can be divided into two subsections. The southern two-thirds consists of sand beaches developed on a low, sand-covered terrace (Nipissing). The southern portion of the subsection is largely developed with houses and shows little sign of major erosion.

The northern one-third of the section contains bluffs up to 60 feet high. The slopes are sparsely vegetated except at ends of the subsection where the bluff grades into the terrace surface. The stratigraphy of the bluffs consist of 5 to 10 feet of Two Rivers till over 30 to 40 feet of another till unit. This till overlies 15 to 20 feet of sand. The lower one-half to one-third of the bluff is covered by debris from shallow slides. No major slumps were observed. The beach in this subsection is 5 to 7 feet wide and consists of sand.

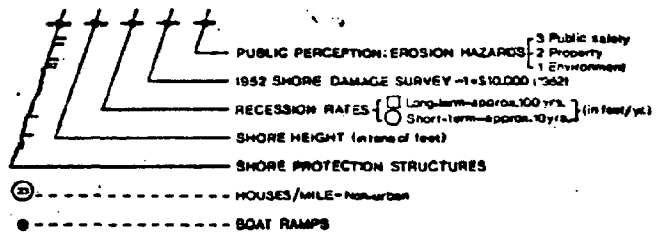
T. 26 N. Sections 29, 28, 21, 16, 9, 4, 3

T. 27 N. Sections 34, 27

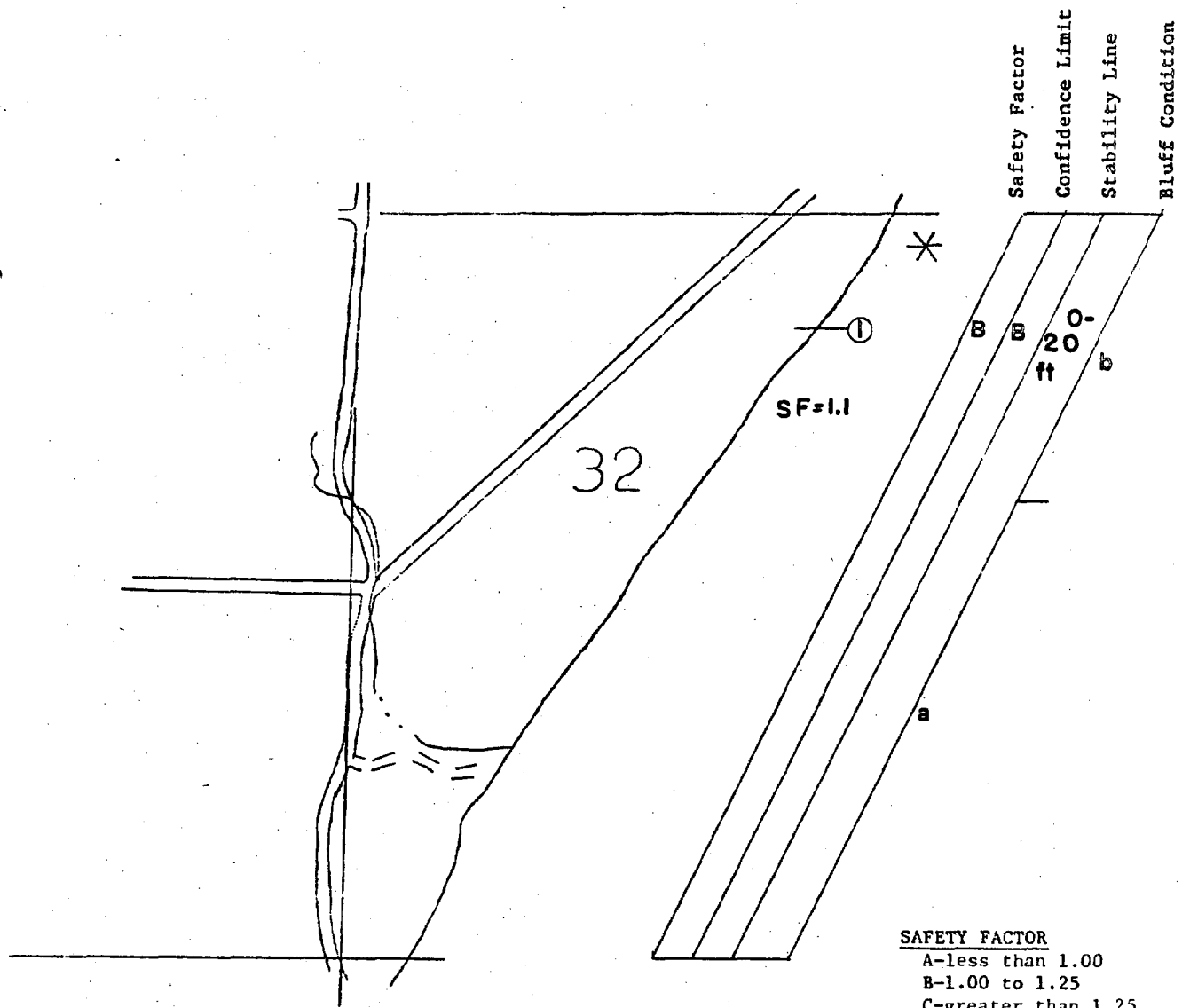
Shorelines of these sections consist of broad sand beaches developed on the 605 foot Nipissing terrace surface. The terrace surface is flat and is 0.1 to 0.4 miles wide. Bedrock intersects the beach and terrace at several locations along the shoreline (marked with X on section maps). This is reflected in concentrations of dolomite boulders and slabs on the beach and offshore. The terrace surface is approximately 60 percent wooded along its length and contains an average of about 5 houses per mile. (An exception is T. 27 N., Sec. 27 which contains over 30 houses along the shore). No shore protection structures are present and erosion is not a major problem.



T 26N.



T.26N., R.26E.  
(H.3.0.00)



**SAFETY FACTOR**

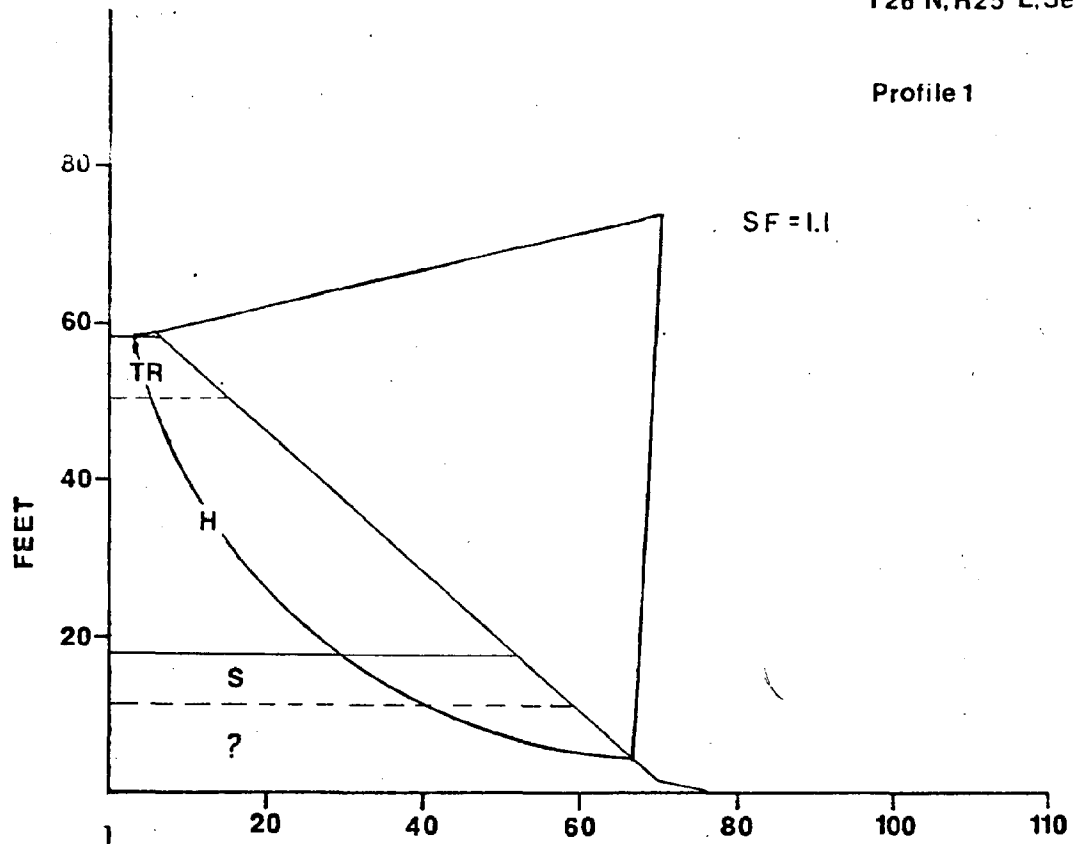
- A-less than 1.00
- B-1.00 to 1.25
- C-greater than 1.25

**CONFIDENCE LEVEL**

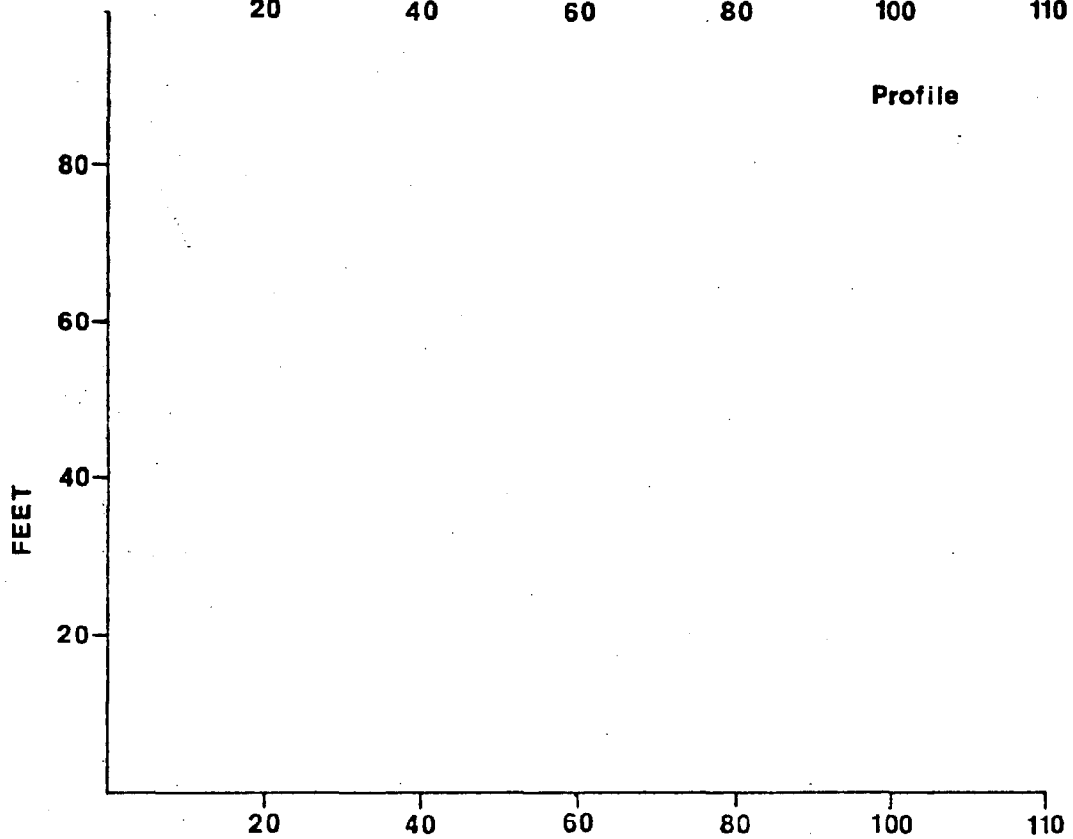
- A-boreholes  
(high confidence)
- B-near boreholes  
stratigraphy visible
- C-no stratigraphy  
visible (low  
confidence)

T26 N, R25 E, Sec. 32

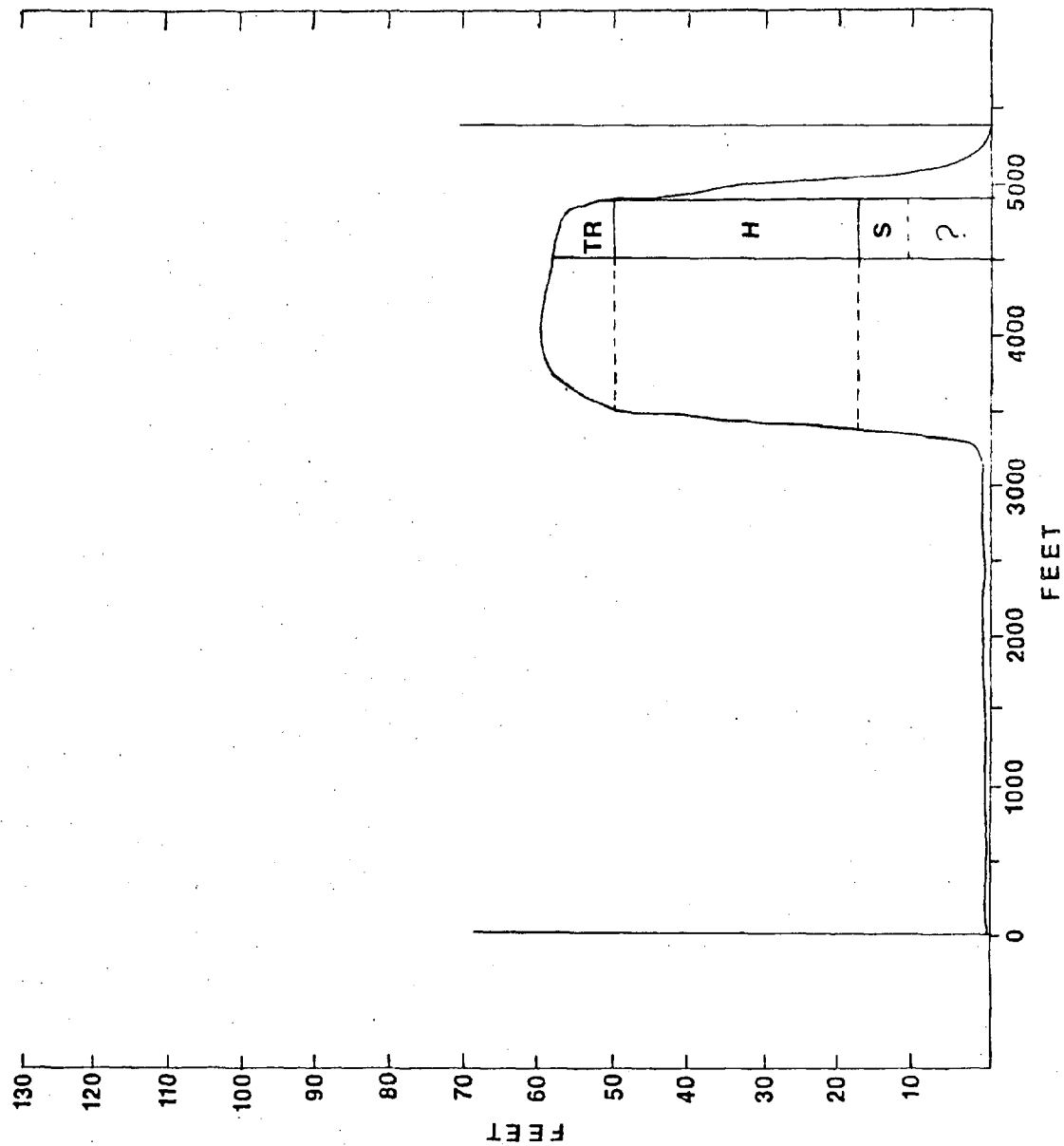
Profile 1



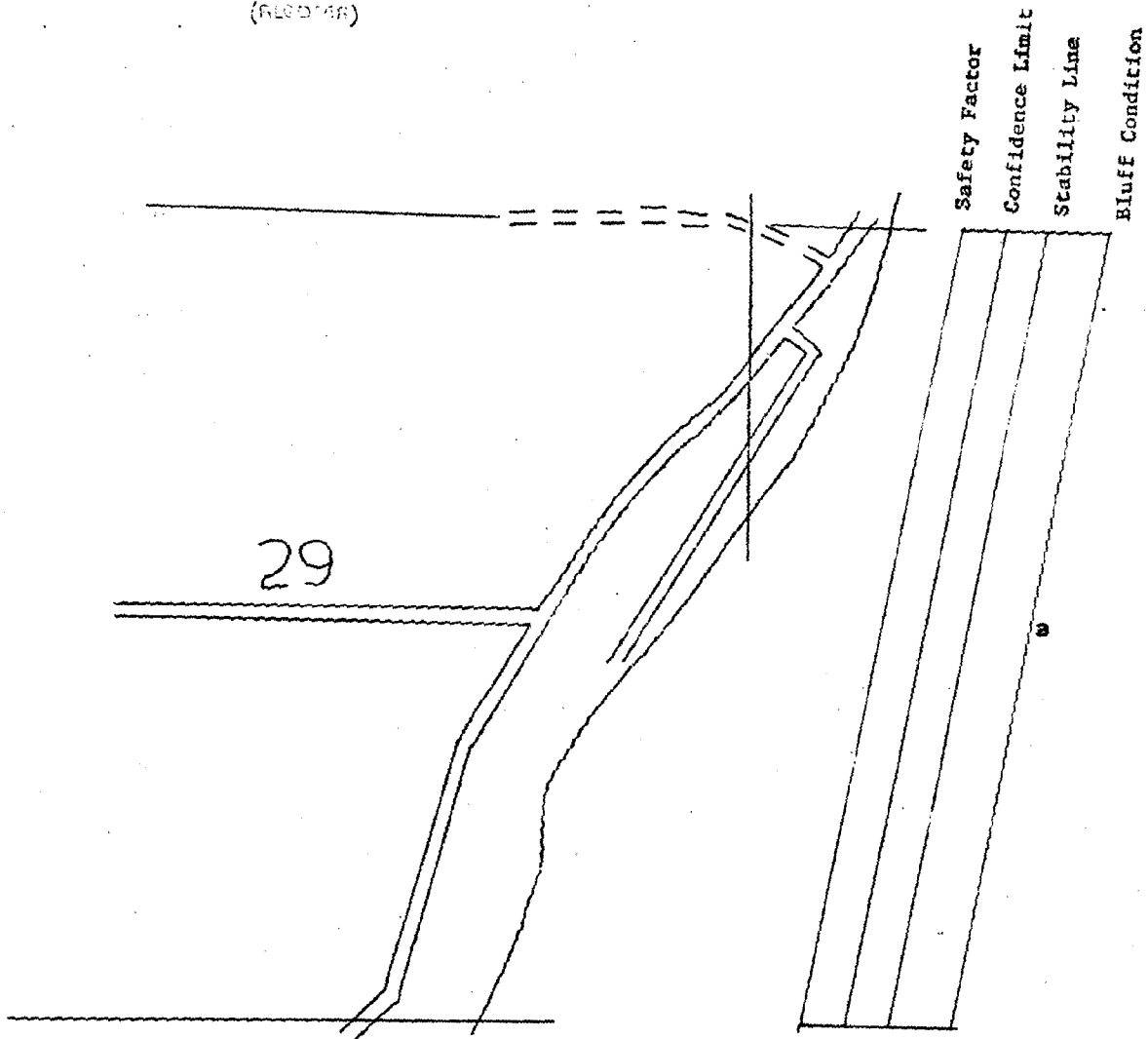
Profile



T26N R25E, SEC. 32



T. 26 N., R. 28 E.  
(REEDS)



SAFETY FACTOR

- A-less than 1.00
- B-1.00 to 1.25
- C-greater than 1.25

CONFIDENCE LEVEL

- A-boreholes  
(high confidence)
- B-near boreholes  
stratigraphy visible
- C-no stratigraphy  
visible (low  
confidence)



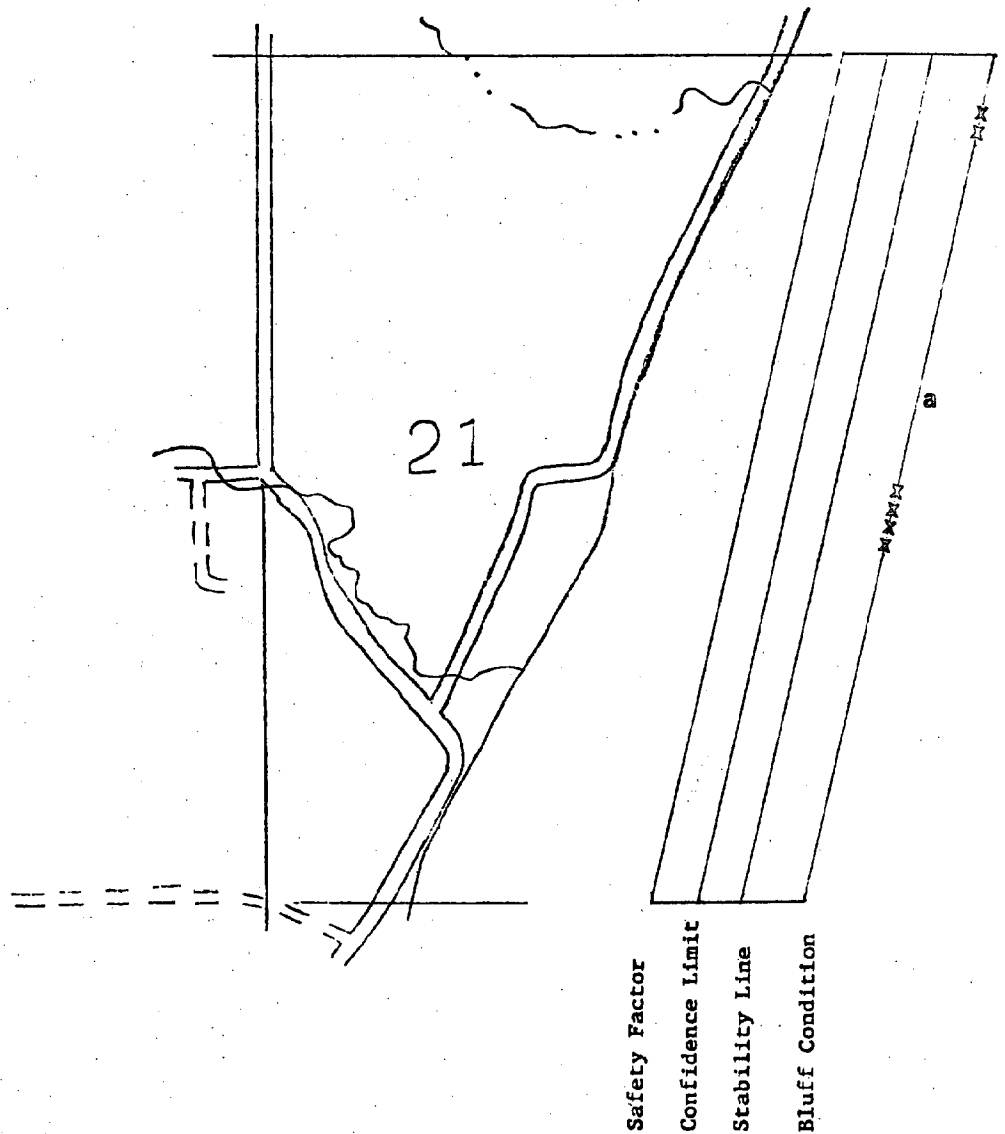
T23N, R23E  
(M-100)

SAFETY FACTOR

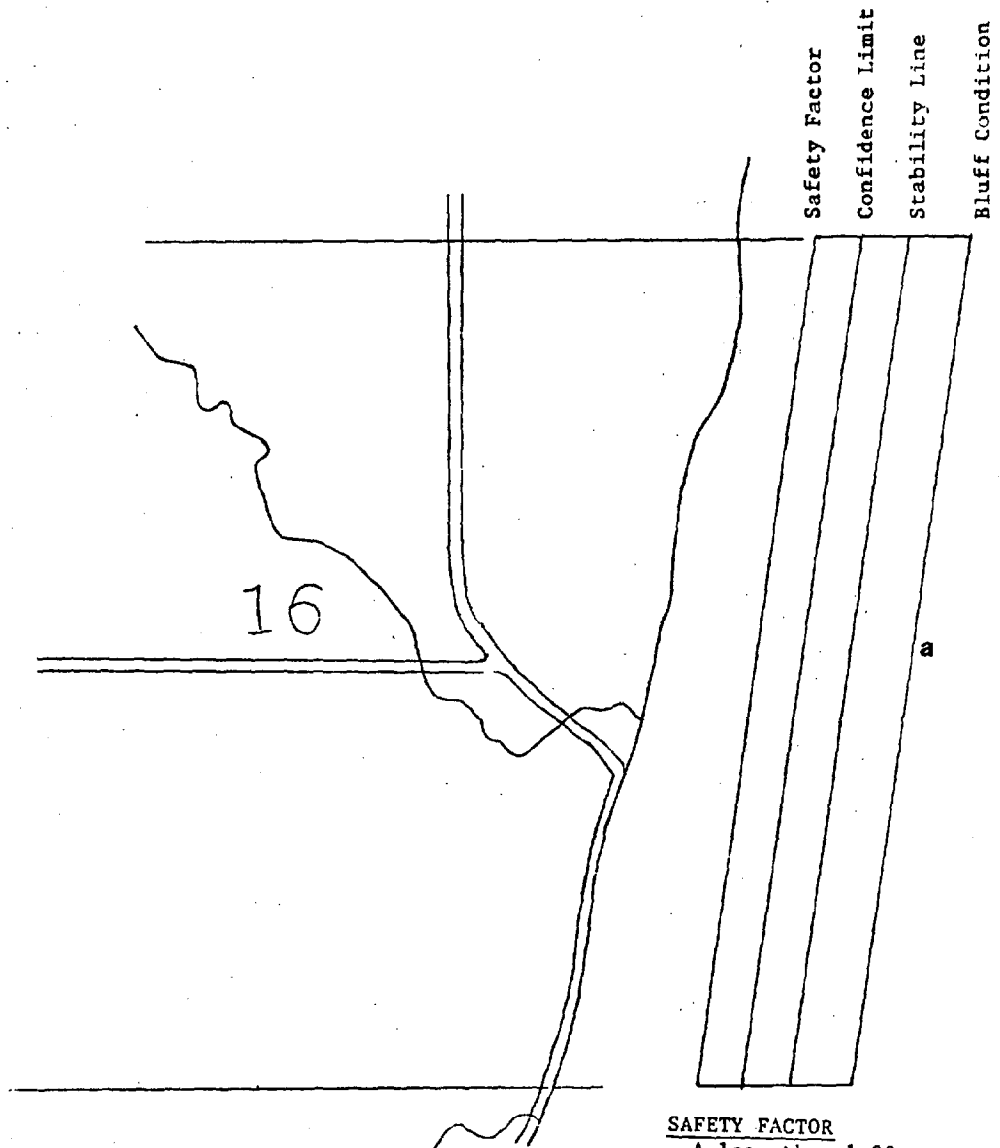
A-less than 1.00  
B-1.00 to 1.25  
C-greater than 1.25

CONFIDENCE LEVEL

A-boreholes  
(high confidence)  
B-near boreholes  
stratigraphy visible  
C-no stratigraphy  
visible (low  
confidence)



T.28 N., R.16 E.  
(P.10000)



SAFETY FACTOR

- A-less than 1.00
- B-1.00 to 1.25
- C-greater than 1.25

CONFIDENCE LEVEL

- A-boreholes  
(high confidence)
- B-near boreholes  
stratigraphy visible
- C-no stratigraphy  
visible (low  
confidence)

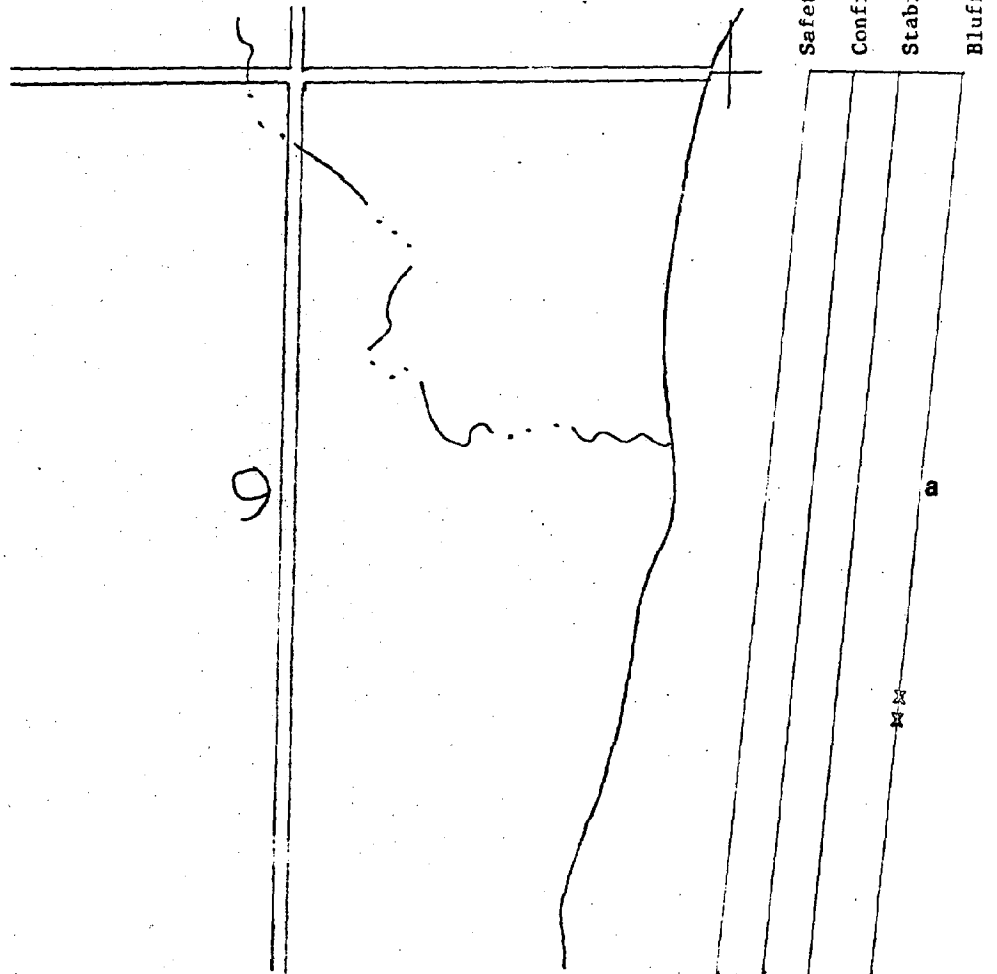
TE 26N, R 26E  
(ALBONA)

SAFETY FACTOR

- A-less than 1.00
- B-1.00 to 1.25
- C-greater than 1.25

CONFIDENCE LEVEL

- A-boreholes  
(high confidence)
- B-near boreholes  
stratigraphy visible
- C-no stratigraphy  
visible (low confidence)



Safety Factor  
Confidence Limit  
Stability Line  
Bluff Condition

T26N., P.26E.  
(1000 (ft))

SAFETY FACTOR

A-less than 1.00

B-1.00 to 1.25

C-greater than 1.25

CONFIDENCE LEVEL

A-boreholes

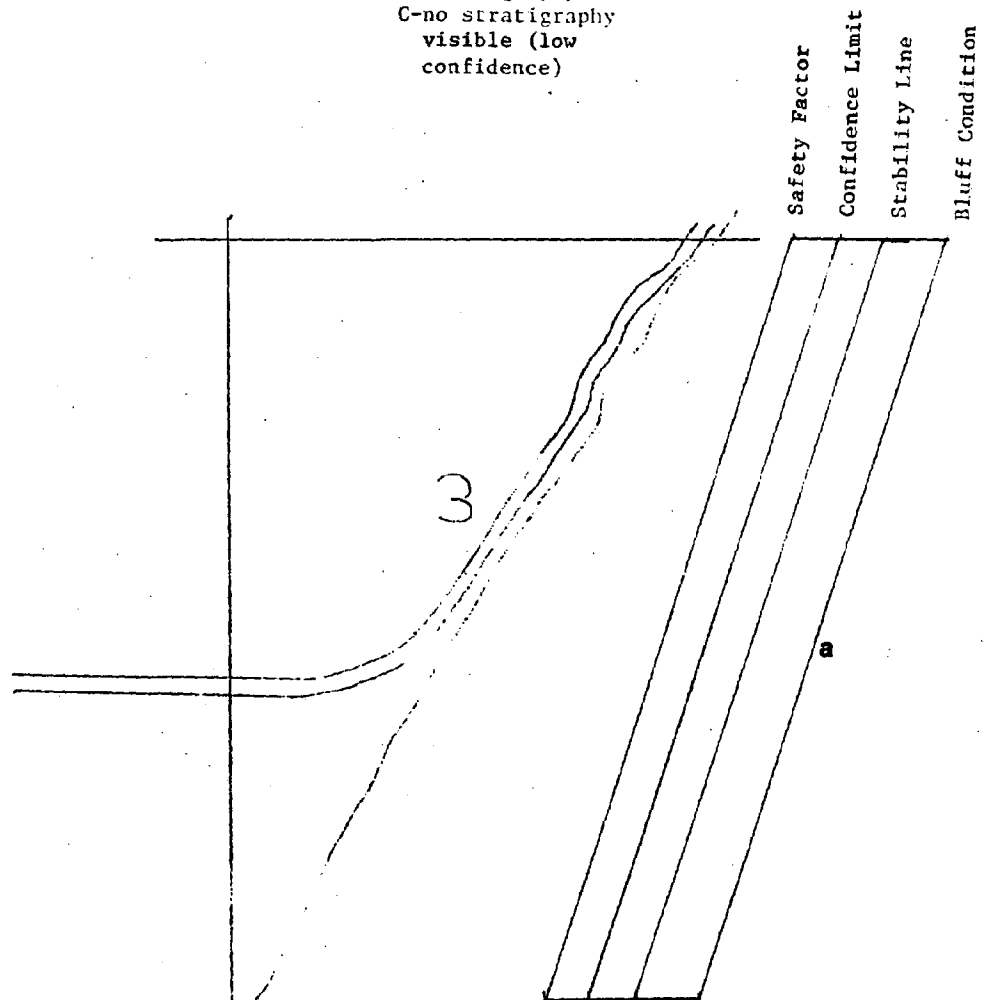
(high confidence)

B-near boreholes

stratigraphy visible

C-no stratigraphy

visible (low  
confidence)



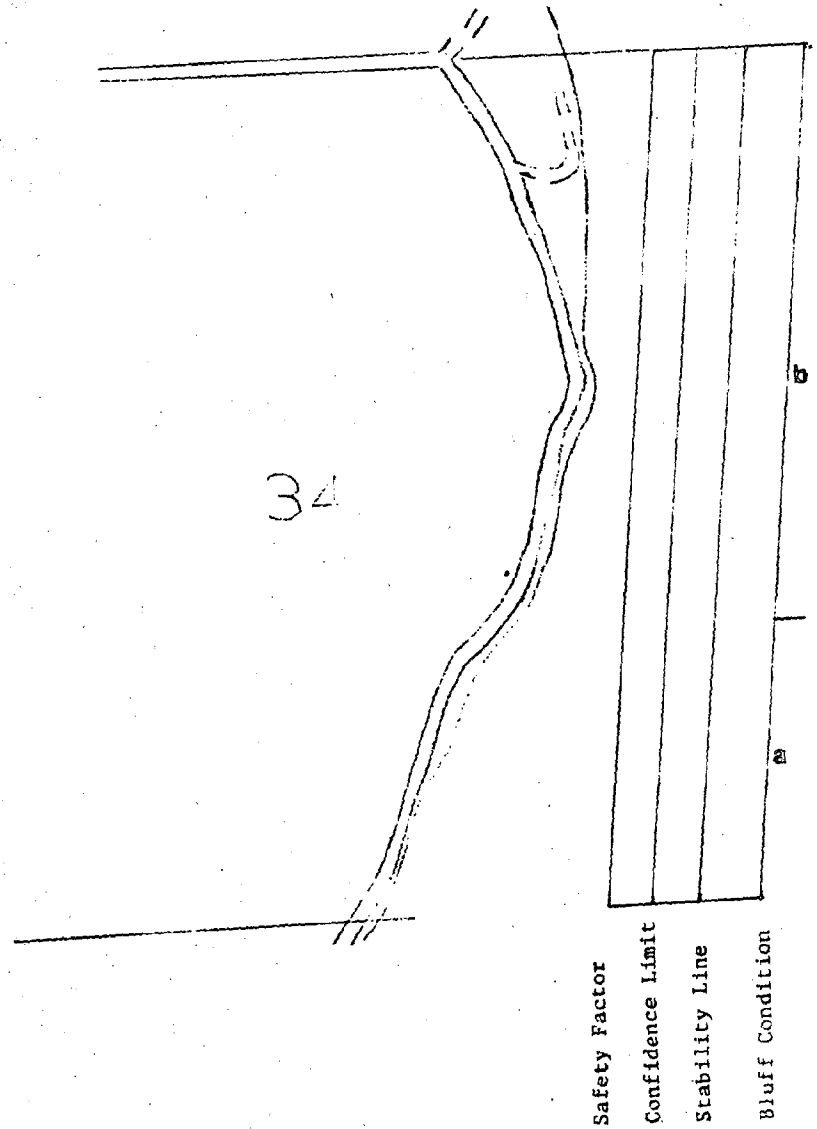
T27N R3E  
(CROSS SECTION)

SAFETY FACTOR

- A-less than 1.00
- B-1.00 to 1.25
- C-greater than 1.25

CONFIDENCE LEVEL

- A-boreholes  
(high confidence)
- B-near boreholes  
stratigraphy visible
- C-no stratigraphy  
visible (low confidence)



T27N R14E

C1000

SAFETY FACTOR

- A-less than 1.00
- B-1.00 to 1.25
- C-greater than 1.25

CONFIDENCE LEVEL

- A-boreholes  
(high confidence)
- B-near boreholes  
stratigraphy visible
- C-no stratigraphy  
visible (low  
confidence)

